

AMENDMENT OF SOLICITATION/MODIFICATION OF CONTRACT				1. CONTRACT ID CODE		PAGE OF PAGES	
		1		10			
2. AMENDMENT/MODIFICATION NO. 0001		3. EFFECTIVE DATE 31-Aug-2001		4. REQUISITION/PURCHASE REQ. NO. W16ROE-1207-8979		5. PROJECT NO.(If applicable)	
6. ISSUED BY USA ENGINEER DISTRICT, NEW YORK ATTN: CENAN-CT ROOM 1843 26 FEDERAL PLAZA (DACA51) NEW YORK NY 10278-0090		CODE DACA51		7. ADMINISTERED BY (If other than item 6)		CODE	
				See Item 6			
8. NAME AND ADDRESS OF CONTRACTOR (No., Street, County, State and Zip Code)				X		9A. AMENDMENT OF SOLICITATION NO. DACA51-01-B-0026	
				X		9B. DATED (SEE ITEM 11) 16-Aug-2001	
						10A. MOD. OF CONTRACT/ORDER NO.	
						10B. DATED (SEE ITEM 13)	
CODE		FACILITY CODE					
11. THIS ITEM ONLY APPLIES TO AMENDMENTS OF SOLICITATIONS							
<input checked="" type="checkbox"/> The above numbered solicitation is amended as set forth in Item 14. The hour and date specified for receipt of Offer <input type="checkbox"/> is extended, <input checked="" type="checkbox"/> is not extended.							
<p>Offer must acknowledge receipt of this amendment prior to the hour and date specified in the solicitation or as amended by one of the following methods:</p> <p>(a) By completing Items 8 and 15, and returning _____ copies of the amendment; (b) By acknowledging receipt of this amendment on each copy of the offer submitted; or (c) By separate letter or telegram which includes a reference to the solicitation and amendment numbers. FAILURE OF YOUR ACKNOWLEDGMENT TO BE RECEIVED AT THE PLACE DESIGNATED FOR THE RECEIPT OF OFFERS PRIOR TO THE HOUR AND DATE SPECIFIED MAY RESULT IN REJECTION OF YOUR OFFER. If by virtue of this amendment you desire to change an offer already submitted, such change may be made by telegram or letter, provided each telegram or letter makes reference to the solicitation and this amendment, and is received prior to the opening hour and date specified.</p>							
12. ACCOUNTING AND APPROPRIATION DATA (If required)							
13. THIS ITEM APPLIES ONLY TO MODIFICATIONS OF CONTRACTS/ORDERS. IT MODIFIES THE CONTRACT/ORDER NO. AS DESCRIBED IN ITEM 14.							
A.THIS CHANGE ORDER IS ISSUED PURSUANT TO: (Specify authority) THE CHANGES SET FORTH IN ITEM 14 ARE MADE IN THE CONTRACT ORDER NO. IN ITEM 10A.							
B.THE ABOVE NUMBERED CONTRACT/ORDER IS MODIFIED TO REFLECT THE ADMINISTRATIVE CHANGES (such as changes in paying office, appropriation date, etc.) SET FORTH IN ITEM 14, PURSUANT TO THE AUTHORITY OF FAR 43.103(B).							
C.THIS SUPPLEMENTAL AGREEMENT IS ENTERED INTO PURSUANT TO AUTHORITY OF:							
D.OTHER (Specify type of modification and authority)							
E. IMPORTANT: Contractor <input type="checkbox"/> is not, <input type="checkbox"/> is required to sign this document and return _____ copies to the issuing office.							
14. DESCRIPTION OF AMENDMENT/MODIFICATION (Organized by UCF section headings, including solicitation/contract subject matter where feasible.) The purpose of this amendment is as follows: to make revisions to the plans and specifications. The proposal due date remains 2PM, 17 September 2001. This contract is subject to 52.232.5001, Continuing Contracts, therefore, the sum of \$12 million has been reserved for this fiscal year. This amendment shall be attached to the specifications and shall be a part thereof. The offeror is required to acknowledge receipt of this amendment either by completing the space provided on the Offer and Award or Contract form when that form is submitted with the proposal, or by separate letter, or by telegram prior to the opening of the proposal. Failure to acknowledge all amendments may cause rejection of the proposal.							
Except as provided herein, all terms and conditions of the document referenced in Item 9A or 10A, as heretofore changed, remains unchanged and in full force and effect.							
15A. NAME AND TITLE OF SIGNER (Type or print)				16A. NAME AND TITLE OF CONTRACTING OFFICER (Type or print)			
15B. CONTRACTOR/OFFEROR		15C. DATE SIGNED		16B. UNITED STATES OF AMERICA		16C. DATE SIGNED	
_____ (Signature of person authorized to sign)				BY _____ (Signature of Contracting Officer)		31-Aug-2001	

SECTION SF 30 BLOCK 14 CONTINUATION PAGE

SUMMARY OF CHANGES

Changes in Section SF 30

**NOTICE TO BIDDERS**

Failure of the bidder to  
Acknowledge receipt of  
this Amendment in  
Item 19 of Standard Form  
1442 (Pg. 00010-2) may  
result in REJECTION of  
the bid.

IFB NO. DACA51-01-B-0026

Amendment No. 1

Department of the Army, NYD  
Corps of Engineers  
New York, NY 10278-0090

AMENDMENT NO.1 TO SPECIFICATIONS ISSUED 17 AUGUST 2001 FOR  
FY-2001 **BATTLE SIMULATION CENTER, FORT DRUM, NEW YORK**

**TO BIDDER**

1. The following specification sections are included as part of this Amendment:

**SECTION 01351 - SAFETY, HEALTH, AND EMERGENCY RESPONSE  
(HTRW/UST)**

SECTION 01450 - CHEMICAL DATA QUALITY CONTROL

SECTION 02111 – EXCAVATION AND HANDLING OF CONTAMINATED  
MATERIAL

SECTION 02115 – UNDERGROUND STORAGE TANK REMOVAL

SECTION 02120 – TRANSPORTATION AND DISPOSAL OF HAZARDOUS  
MATERIALS

SECTION 02930 – EXTERIOR PLANTING

SECTION 05090 – WELDING, GENERAL

SECTION 10440 – INTERIOR SIGNAGE

SECTION 13945 – PREACTION SPRINKLER SYSTEM, FIRE PROTECTION

SECTION 14240 – ELEVATORS, HYDRAULIC

SECTION 15995 – COMMISSIONING OF HVAC SYSTEMS

SECTION 15951 – DIRECT DIGITAL CONTROLS FOR HVAC (NETWORKED  
BUILDING CONTROLLER)

SECTION 15951A- SEQUENCE OF OPERATIONS-AIR COOLED HELICAL  
ROTARY CHILLERS SYSTEM CONTROLS

SECTION 15951B-SEQUENCE OF OPERATIONS-VAV AIR HANDLING UNITS  
WITH STATIC PRESSURE OPTIMIZATION

SECTION 15951C-SEQUENCE OF OPERATIONS-VARIABLE AIR VOLUME  
TERMINAL UNITS

SECTION 15951D-SEQUENCE OF OPERATIONS-ANCILLIARY EQUIPMENT  
CONTROLS (CABINET UNIT HEATERS, EXHAUST FANS,  
BOILERS, PUMPS, GAS AND ELECTRIC METERS, ETC.)

2. Below are miscellaneous changes to existing specifications:

**a. SECTION 00800 – SPECIAL CONTRACT REQUIREMENTS**

Paragraph 1.2.a – Change “.....Government as liquidated damages , the sum of \$370 for each day of delay” to “ .....Government as liquidated damages , the sum of \$1,714 for each day of delay.

**b. SECTION 02220 – DEMOLITION.**

Insert Paragraph 1.1.1, to read as follows:

“1.1.1 Removal and Disposal of Asbestos Containing Materials and Lead Based Paint.

Prior to start of demolition work, all asbestos containing material (ACM) and all lead based paint (LBP) must be removed and disposed in compliance with USACE EM-385-1-1, current Federal, State, and local rules and regulations, and Contract documents.”

Paragraph 1.1 – After the words “asbestos abatement” insert the words “lead based paint abatement”.

Paragraph 1.7 – In lieu of the existing Item K insert the following:

“k. Work and abatement plan for removal and disposal of asbestos containing material (ACM): vinyl floor tiles, pipe insulation, lead based paint, and five (5) underground storage tanks. (See BSC Dwgs H - 001, H - 002, H - 003, H - 004, and H - 005.”

Paragraph 5.1.5 – In lieu of “Dwg ACM - 001” use “Dwg H - 001”.

Paragraph 5.1.6 – In lieu of “Dwg LBP - 001” use “Dwg H - 002”.

**c. SECTION 07570 – SPRAYED POLYURETHANE FOAM (SPF)**

Paragraph 3.3.3 – Delete the whole text of the paragraph, and replace with the following:

“Foam shall be sprayed on the prepared surface, as noted in Specification Section 07412 NON-STRUCTURAL METAL ROOFING in 13 to 25 mm (1/2 to 1 inch) lifts. Time between lifts shall not exceed 4 hours. The finished surface shall be "orange peel" or smoother. An approved sample shall be used as the standard for determining the acceptability of the foam finish. Cured foam shall be free from water, dust, oils, and other materials which would impair adhesion of the protective coating. No foam shall be allowed to stand overnight without a protective covering. Foam shall cure at least 1 hour, unless otherwise recommended by the manufacturer before application of protective coating. Any non adherence of foam to substrate shall be corrected and pinholes shall be finished flush with an approved sealant before finish coating is applied. Over spraying to correct an unacceptable surface condition will not be permitted. The finished insulation shall not vary more than 6 mm (1/4 inch) when measured with 3 m (10 foot) straight edge parallel and perpendicular to the roof slope. Apply foam as required, to be flush with the top of the wood blocking fastened to the top flange of “Z” purlins (see drawings for details). Apply each spray pass at right angles to the previous pass to the extent practicable. Each pass shall be between 13mm (1/2 inch) and 25 mm (1 inch) in thickness. Minimum total

thickness is 152 mm (6 inches). Corrections to foam thickness by shaving are to be held to a minimum. All shaved areas shall receive 1 coat of Evercoat 500 acrylic paint or approved equal.

**d. SECTION 09900A – PAINTING, GENERAL.**

Paragraph 1.1 - Delete Reference FAA AC 70/7460-1 Obstruction Marking and Lighting.

**e. SECTION 10800 – TOILET ACCESSORIES.**

Paragraph 1.1 – Delete References CID A-A-2380 Dispenser, Paper Towel and CID A-A-2398 Curtain, Shower and Window.

Paragraph 3.3 – Place ” MM” in lieu of “MH”.

**f. SECTION 13920 – FIRE PUMPS**

Paragraph 2.4.4.4 – Change “Relief valve shall be pilot operated or spring operated type conforming to . . . .” to “Relief valve shall pilot operated type conforming to ....”

**g. SECTION 13930 – WET PIPE SPRINKLER SYSTEM**

Paragraph 1.1 – Add “NFPA 20 – Standard for the Installation of Stationary Pumps for Fire Protection 1999 Edition” to the list under NFPA.

Paragraph 2.4.1 – Change “Piping from a point 150 mm (6 inches) above the floor to a point 1500 mm (5 feet) outside the building wall.” to “Piping from a point 150 mm (6 inches) above the floor to a point 1500 mm (5 feet) outside the building wall shall be ductile iron with a rated working pressure of 1207 Kpa (175 psi) conforming to AWWA C 151, with cement mortar lining conforming to AWWA C 104.”

Paragraph 2.5 – Change “Aboveground piping shall be steel or copper” to “Above-ground piping shall be schedule 40 black steel pipe.”

Paragraph 2.5.2 – Delete paragraph 2.5.2 Copper Tube Components.

Paragraph 2.10 – Change “Temperature classification shall be ordinary or intermediate” to “Temperature classification shall be ordinary.”

Paragraph 2.13 – Delete paragraph 2.13 Fire Hose Assembly.

Paragraph 2.8.2 – Delete paragraph 2.8.2 Sprinkler Pressure (Waterflow) Alarm Switch

**h. SECTION 15070 SEISMIC PROTECTION FOR MECHANICAL EQUIPMENT**

Paragraph 1.2.5.1 – Change “Section 13920 FIRE PUMPS” to “Section 13945 PREACTION SPRINKLER SYSTEM, FIRE PROTECTION”.

**i. SECTION 15400 – PLUMBING, GENERAL PURPOSE**

Paragraph 2.1.1 – Delete item “o. Plastic Solvent Cement . . . .” from the list of conformance.

Paragraph 2.8 – Delete the second sentence of the paragraph “Each primary water

heater.....to 120 degrees F)”.

Paragraph 2.8.1 – Change title of the paragraph to “Gas-Fired Type Water Heaters”.

Add new paragraph 2.11 as follows:

**“2.11 DOMESTIC WATER SERVICE METER**

Cold water meter shall be of the positive displacement type conforming to AWWA C700. Meter register may be round or straight reading type, indicating as provided by the local utility. Meter shall be provided with a pulse generator, remote readout register and all necessary wiring and accessories.

**1.11.1 Water Meter Remote Readout Register**

The remote readout register shall be mounted as the location as directed by the Contracting Officer.

**j. SECTION 13851 – FIRE DETECTION AND ALARM SYSTEM, ADDRESSABLE**

Paragraph 1.4.3 Alarm Functions: delete the last function “e. Operation of the smoke control system”.

Paragraph 2.6.1 – Add the following sentence to the end of this paragraph: “Visible appliances that are in any field of view and are separated less than 16.8 m (55 feet) must have synchronized flashes.”

**k. SECTION 16375 – ELECTRICAL DISTRIBUTION SYSTEM, UNDERGROUND**

a. Add paragraph 2.9.2 as follows:

**“2.9.2 Pad-Mounted, Metal-Enclosed, Switchgear**

The switchgear shall be configured with two (2) incoming compartments for loop-feed arrangement SF6-insulated, load-interrupter switches, as indicated. The outgoing compartments shall be provided as indicated.

**2.9.2.1 Ratings at 60 Hz shall be:**

Nominal voltage (kV). . . . .	13.2
Rated maximum voltage (kV) . . . . .	15
Rated continuous current (A) . . . . .	200
Maximum symmetrical interrupting capacity (kA) . . . . .	12
Maximum asymmetrical interrupting capacity (kA) . . . . .	20
BIL (kV) . . . . .	95

**2.9.2.2 Operators, Devices, and Controls**

Operators and controls shall be provided for the switchgear as follows:

a. Switches shall be provided with a manual, handle-type operator or a push-button mechanical spring tripping mechanism, utilizing a stored-energy (spring-driven) mechanism to simultaneously open or close all phases. The switchgear shall be configured so that the switch actuator is pad-lockable, but may be

accessed without opening the switch compartment doors. Mechanical interlock shall be provided for the incoming SF6 load interrupter switches.

- b. Fused disconnects shall be hook-stick operated.

#### 2.9.2.3 Enclosure

Switchgear enclosures shall be of freestanding, self-supporting construction provided with separate incoming and outgoing compartments configured for bottom cable entry. Enclosures shall be of deadfront construction, provided with a hinged door for access to each compartment, and conform to the requirements of ANSI C57.12.28, ANSI C37.72, and IEEE C37.20.3, Category A.”

- b. Paragraph 2.17 – Add the following to end of paragraph 2.17 FACTORY TESTS:

“d. Outdoor Switchgear: Manufacturer’s standard tests in accordance with IEEE ANSI/IEEE C37.20.1, IEEE ANSI/IEEE C37.20.2 and IEEE ANSI/IEEE C37.20.3.”

- c. Paragraph 3.11.8 – Add the following to end of paragraph 3.11.8 Pre-Energization Services:

“c. Metal Enclosed Switchgear.”

### 1. SECTION 16411 MANUAL TRANSFER SWITCH

Delete Section 16411 without substitution.

### 3.Index of Drawings:

Change all five (5) Fire Protection Drawings **“FP” to “F”**; ( eg. **FP – 001 Fire Protection - General Notes and Legend** ) should now read **“ F – 001 Fire Protection, General Notes and Legend, etc.**

### 4.Add the following new drawings:

H – 003 Removal and Disposal of Underground Storage Tanks  
 H – 004 Removal and Disposal of Underground Storage Tanks  
 H – 005 Removal and Disposal of Underground Storage Tanks  
 S – 115 Details – Main Entrance

### 5.The following is a list of revised drawings to be issued with this Amendment:

1. E-001 Electrical Legend and Notes
2. E-103 Attic Lighting Plan
3. E-104 First Floor Power Plan
4. E-105 Second Floor Power plan
5. E-107 First Floor Fire Alarm Plan
6. E-108 Second Floor Fire Alarm Plan
7. E-109 Attic Fire Alarm Plan
8. E-110 Lighting Protection and Grounding System Plan
9. E-401 Electrical Site Plan Part I
10. E-501 Electrical Details I
11. E-504 Electrical Details IV
12. E-505 Electrical Details V
13. E-601 One Line Diagram

14. E-602 Fire Alarm Riser Diagram
15. E-606 Panel Schedule IV
16. P-402 Details II
17. C-1 Site Plan
18. C-2 Site Plan 2
19. C-3 Grading and Drainage Plan
20. C-5 Storm Drainage Outfall
21. C-15 Site Details 1
22. C-16 Site Details 2
23. S-101 General Notes
24. S-102 Foundation Plan
25. S-103 Foundation Sections & Details
26. S-104 Second Floor Framing Plan
27. S-105 Attic Floor Framing Plan
28. S-106 Roof Framing Plan
29. S-109 Slab & Misc. Concrete Sections & Details
30. S-110 Column Schedule 1
31. S-114 Joist Loading Diagram
32. M-101 HVAC Duct – First Floor Plan
33. M-102 HVAC Duct Second Floor Plan
34. M-103 HVAC Duct Attic / Fan Room, Third Floor Plan
35. M-105 HVAC Piping – First Floor Plan
36. M-109 HVAC Part Plan – First Floor Toilets
37. M-110 HVAC Part Plan – Second Floor Toilets
38. M-111 HVAC Part Plan – Mechanical Equipment Room
39. P-001 Plumbing Legend, Fixture Schedule, H.W. Heater Schedule
40. P-101 Plumbing ( Supply Water ) – Cold & Hot Domestic Water  
Supply – First Floor Plan
41. P-102 Plumbing ( Supply Water ) – Cold & Hot Domestic Water  
Supply – Second Floor Plan
42. P-103 Plumbing ( Sanitary & Venting ) – First Floor Plan
43. P-104 Plumbing ( Sanitary & Venting ) – Second Floor Plan
44. P-105 Plumbing ( Sanitary & Venting ) – Attic / Fan Room, Third Floor
45. P-106 Plumbing ( Storm Drainage ) – First & Second Floor Plans
46. P-107 Plumbing ( Storm Drainage ) – Attic & Roof Plans & Details
47. A-101 First Floor Plan
48. A-102 Second Floor Plan
49. A-103 Attic Floor Plan
50. A-104 Roof Plan
51. A-201 Building Elevations
52. A-202 Building Elevations
53. A-301 Building Sections
54. A-302 Building Sections
55. A-401 Wall Sections
56. A-402 Wall Sections
57. A-403 Wall Sections
58. A-501 Details
59. A-502 Details
60. A-601 Finish Schedule
61. A-602 Finish Schedule
62. A-603 Door Schedule
63. A-701 Reflected Ceiling Plan – First Floor
64. A-702 Reflected Ceiling Plan – Second Floor
65. A-703 Reflected Ceiling Plan
66. A-801 Miscellaneous

- 67 A-802 Miscellaneous
- 68 A-903 Guard House

**6. Below are changes to existing drawings (drawings are not issued):**

- Drawing F-001 Fire Protection-General Notes and Legend:

Note #2 Fire Protection System Notes:

- a. Change Note #2 from “. . . air compressor rating of 3728.5W (5 HP) . . .” to . . . air compressor rating of 2237.1W (3 HP) . . .”
- b. Add the following sentence to Note #2: “Provide relief valve set at 1035 Kpa (150 psi) between the pump and the pump discharge check valve. Relief valve shall be as per NFPA 20.”
- c. Change Note #2 under “Schedule Notes” from “. . . flow rate of 79.4 L/S (1260 gpm) at entrance to buildings.” to “. . . flow rate of 79.4 L/S (1260 gpm) and fire pump requirements.”

**- Drawing F-104 Fire Protection Details**

- a. Typical Fire Riser Detail: Add note #3: “3. Height of alarm check valve, preaction and wet pipe valves shall be operable at floor level. Provide chain-wheels, or linkages if valves cannot be operable at floor level.”
- b. Typical Preaction Sprinkler Riser Detail: Change item #1 from “Dry Pipe Valve” to “Deluge Valve.”
- c. Note # 2 Schedule Notes

Delete Note # 2 under schedule notes.

Changes in Section 00600

The following clauses which are incorporated by full text have been added or modified:

252.209-7003 COMPLIANCE WITH VETERANS' EMPLOYMENT REPORTING REQUIREMENTS (MAR 1998)

By submission of its offer, the offeror represents that, if it is subject to the reporting requirements of 37 U.S.C. 4212(d) (i.e., the VETS-100 report required by Federal Acquisition Regulation clause 52.222-37, Employment Reports on Disabled Veterans and Veterans of the Vietnam Era), it has submitted the most recent report required by 38 U.S.C. 4212(d).

## SECTION 01351

## SAFETY, HEALTH, AND EMERGENCY RESPONSE (HTRW/UST)

**02/99**

## PART 1 GENERAL1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

## AMERICAN CONFERENCE OF GOVERNMENTAL INDUSTRIAL HYGIENISTS (ACGIH)

ACGIH Threshold Limits	(1998) Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices
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## AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI Z358.1	(1990) Emergency Eyewash and Shower Equipment
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## AMERICAN PETROLEUM INSTITUTE (API)

API Publ 2219	(1986) Safe Operation of Vacuum Trucks in Petroleum Service
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API RP 1604	(1996) Closure Underground Petroleum Storage Tanks
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API Std 2015	(1994) Safe Entry and Cleaning of Petroleum Storage Tanks
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## CODE OF FEDERAL REGULATIONS (CFR)

29 CFR 1904	Recording and Reporting Occupational Injuries and Illnesses
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29 CFR 1910	Occupational Safety and Health Standards
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29 CFR 1926	Safety and Health Regulations for Construction
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49 CFR 171	General Information, Regulations, and Definitions
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49 CFR 172	Hazardous Materials Table, Special Provisions, Hazardous Materials Communications, Emergency Response Information, and Training Requirements
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## ENGINEERING MANUALS (EM)

EM 385-1-1 (1996) U.S. Army Corps of Engineers Safety and Health Requirements Manual

## NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH (NIOSH)

NIOSH Pub No. 85-115 (1985) Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities

## 1.2 DESCRIPTION OF WORK

This section provides additional requirements for implementing the accident prevention provisions of EM 385-1-1, and specifies a Site Safety and Health Plan (SSHP) which shall satisfy the requirements for submission of a separate Accident Prevention Plan (APP) as required by EM 385-1-1. The requirements shall apply to work performed in both "contaminated" and "clean" areas.

## 1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

## SD-02 Shop Drawings

Work Zones; G, RE

Drawings shall include initial work zone boundaries: Exclusion Zone (EZ), including restricted and regulated areas; Contamination Reduction Zone (CRZ); and Support Zone (SZ).

Personnel Decontamination Facilities; G, RE  
Equipment Decontamination Facilities; G, RE

Drawings shall show the layout of the personnel and equipment decontamination [areas] [facilities].

## SD-03 Product Data

Site Control Log; FIO

Record of each entry and exit into the site, as specified.

## SD-06 Test Reports

Exposure Monitoring/Air Sampling Program; G, RE

Personnel exposure monitoring/sampling results.

#### 1.4 REGULATORY REQUIREMENTS

Work performed under this contract shall comply with EM 385-1-1, applicable Federal, state, and local safety and occupational health laws and regulations. This includes, but is not limited to, Occupational Safety and Health Administration (OSHA) standards, 29 CFR 1910, especially Section .120, "Hazardous Waste Site Operations and Emergency Response" and 29 CFR 1926, especially Section .65, "Hazardous Waste Site Operations and Emergency Response". Matters of interpretation of standards shall be submitted to the appropriate administrative agency for resolution before starting work. Where the requirements of this specification, applicable laws, criteria, ordinances, regulations, and referenced documents vary, the most stringent requirements shall apply.

#### 1.5 PRECONSTRUCTION SAFETY CONFERENCE

As soon as practical before commencing the work, the Contractor shall hold a safety conference with the Contracting Officer and any other personnel deemed relevant.

#### 1.6 SAFETY AND HEALTH PROGRAM

OSHA Standards 29 CFR 1910, Section .120 (b) and 29 CFR 1926, Section .65 (b) require employers to develop and implement a written Safety and Health Program for employees involved in hazardous waste operations. The site-specific program requirements of the OSHA Standards shall be integrated into one site-specific document, the Site Safety and Health Plan (SSHP). The SSHP shall interface with the employer's overall Safety and Health Program. Any portions of the overall Safety and Health Program that are referenced in the SSHP shall be included as appendices to the SSHP.

#### 1.7 SITE SAFETY AND HEALTH PLAN

##### 1.7.1 Preparation and Implementation

A Site Safety and Health Plan (SSHP) shall be prepared covering onsite work to be performed by the Contractor and all subcontractors. The Safety and Health Manager shall be responsible for the development, implementation and oversight of the SSHP. The SSHP shall establish, in detail, the protocols necessary for the anticipation, recognition, evaluation, and control of hazards associated with each task performed. The SSHP shall address site-specific safety and health requirements and procedures based upon site-specific conditions. The level of detail provided in the SSHP shall be tailored to the type of work, complexity of operations to be performed, and hazards anticipated. Details about some activities may not be available when the initial SSHP is prepared and submitted. Therefore, the SSHP shall address, in as much detail as possible, anticipated tasks, their related hazards and anticipated control measures. Additional details shall be included in the activity hazard analyses as described in paragraph ACTIVITY HAZARD ANALYSES.

##### 1.7.2 Acceptance and Modifications

Prior to submittal, the SSHP shall be signed and dated by the Safety and Health Manager and the Site Superintendent. The SSHP shall be submitted for review 5 days prior to the Preconstruction Safety Conference. Deficiencies in the SSHP will be discussed at the preconstruction safety conference, and the SSHP shall be revised to correct the deficiencies and resubmitted for acceptance. Onsite work shall not begin until the plan has been accepted. A copy of the written SSHP shall be maintained onsite. As work proceeds, the SSHP shall be adapted to new situations and new conditions. Changes and modifications to the accepted SSHP shall be made with the knowledge and concurrence of the Safety and Health Manager, the Site Superintendent, and the Contracting Officer. Should any unforeseen hazard become evident during the performance of the work, the Site Safety and Health Officer (SSHO) shall bring such hazard to the attention of the Safety and Health Manager, the Site Superintendent, and the Contracting Officer, both verbally and in writing, for resolution as soon as possible. In the interim, necessary action shall be taken to re-establish and maintain safe working conditions in order to safeguard onsite personnel, visitors, the public, and the environment. Disregard for the provisions of this specification or the accepted SSHP shall be cause for stopping of work until the matter has been rectified.

#### 1.7.3 Availability

The SSHP shall be made available in accordance with 29 CFR 1910, Section .120 (b)(1)(v) and 29 CFR 1926, Section .65 (b)(1)(v).

#### 1.7.4 Elements

Topics required by 29 CFR 1910, Section .120 (b)(4) 29 CFR 1926, Section .65 (b)(4) and the Accident Prevention Plan as described in Appendix A of EM 385-1-1 and those described in this section shall be addressed in the SSHP. Where the use of a specific topic is not applicable to the project, the SSHP shall include a statement to justify its omission or reduced level of detail and establish that adequate consideration was given the topic.

### 1.8 SITE DESCRIPTION AND CONTAMINATION CHARACTERIZATION

#### 1.8.1 Project/Site Conditions

The following information is a record of site contaminants and a description of the site. This information is provided to assist in preparing the SSHP. Additional sources of information are available as listed below.

##### 1.8.1.1 Site Information

The underground storage tanks addressed by this project have been confirmed as having contained fuel oil. However, additional testing is required to verify the accuracy of this report.

#### 1.8.2 Plan Requirements

The SSHP shall include a site description and contamination characterization section that addresses the following elements:

a. Description of site location, topography, size and past uses of the site.

b. A list of contaminants which may present occupational health and safety hazards. This list shall be created by evaluating the analytical results in this section and by researching sources of information from past site investigation activities. Chemical names, concentration ranges, media in which found, locations onsite, and estimated quantities/volumes to be impacted by site work shall be included if known. The contamination characterization shall be reviewed and revised if new chemicals are identified as work progresses.

#### 1.9 HAZARD/RISK ANALYSIS

The SSHP shall include a safety and health hazard/risk analysis for each site task and operation to be performed. The hazard/risk analysis shall provide information necessary for determining safety and health procedures, equipment, and training to protect onsite personnel, the environment, and the public. Available site information shall be reviewed when preparing the "Hazard/Risk Analysis" section of the SSHP. The following elements, at a minimum, shall be addressed.

##### 1.9.1 Site Tasks and Operations (Workplan)

The SSHP shall include a comprehensive section that addresses the tasks and objectives of the site operations and the logistics and resources required to reach those tasks and objectives. Based on the type of remediation required, the following is a list of anticipated major site tasks and operations to be performed:

1. Backhoe operation, general.
2. Material handling, storage, and disposal.
3. Personal protective equipment use.
4. UST inerting and cleaning.
5. Welding and cutting.
6. Tank removal from the ground.
7. Tank disposal.
8. Excavation, filling, and backfilling.
9. Decontamination.
10. Soil sampling.

This is not a complete list of site tasks and operations; therefore, it shall be expanded and/or revised, during preparation of the SSHP as necessary.

### 1.9.2 Hazards

The following potential hazards may be encountered during site work. These are not complete lists; therefore, they shall be expanded and/or revised as necessary during preparation of the SSHP.

#### 1.9.2.1 Safety Hazards

1. Heavy equipment operation.
2. Slip, trip, and fall hazards.
3. Trenching excavations.
4. Adverse weather -- thunder/lightning, tornadoes, hail, ice storms.
5. Materials handling safety -- back safety.
6. Temperature stress -- heat and/or cold.
7. Overhead hazards.
8. Electrical hazards.

#### 1.9.2.2 Chemical Hazards

Potential chemical hazards that may be encountered during site work are discussed in paragraph SITE DESCRIPTION AND CONTAMINATION CHARACTERIZATION.

The Hazard/Risk Analysis section of the SSHP shall describe the chemical, physical, and toxicological properties of contaminants, sources and pathways of employee exposures, anticipated onsite and offsite exposure level potentials, and regulatory (including Federal, state, and local) or recommended protective exposure standards. The SSHP shall also address employee exposure to hazardous substances brought onsite, and shall comply with the requirements of 29 CFR 1910, Section .1200 and 29 CFR 1926, Section .59, Hazard Communication.

#### 1.9.2.3 Physical Agents

Physical agents are essentially the same as safety hazards in paragraph 1.9.2.1.

#### 1.9.2.4 Biological Hazards

Potential biological hazards may include snakes and vector borne diseases which may be encountered during site work. The Contractor shall provide a detailed list of biological hazards during preparation of the SSHP.

### 1.9.3 Action Levels

#### 1.9.3.1 General Requirements

Action levels shall be established for the situations listed below, at a minimum. The action levels and required actions (engineering controls, changes in PPE, etc.) shall be presented in the SSHP in both text and tabular form.

- a. Implementation of engineering controls and work practices.
- b. Upgrade or downgrade in level of personal protective equipment.
- c. Work stoppage and/or emergency evacuation of onsite personnel.
- d. Prevention and/or minimization of public exposures to hazards created by site activities.

#### 1.9.3.2 Confined Space Entry

Entry into and work in a confined space will not be allowed when oxygen readings are less than 19.5% or greater than 23.5% or if the Lower Flammable Limit (LFL) reading is greater than 10%, unless these conditions are adequately addressed in the confined space entry program. In addition, action levels for toxic atmospheres shall be determined.

#### 1.10 ACTIVITY HAZARD ANALYSES

Prior to beginning each major phase of work, an Activity Hazard Analysis shall be prepared by the Contractor performing that work and submitted for review and acceptance. The format shall be in accordance with EM 385-1-1, figure 1-1. A major phase of work is defined as an operation involving a type of work presenting hazards not experienced in previous operations or where a new subcontractor or work crew is to perform. The analysis shall define the activities to be performed and identify the sequence of work, the specific hazards anticipated, and the control measures to be implemented to eliminate or reduce each hazard to an acceptable level. Work shall not proceed on that phase until the activity hazard analysis has been accepted and a preparatory meeting has been conducted by the Contractor to discuss its contents with everyone engaged in the activities, including the government onsite representatives. The activity hazard analyses shall be continuously reviewed and when appropriate modified to address changing site conditions or operations, with the concurrence of the Safety and Health Manager, the Site Superintendent, and the Contracting Officer. Activity hazard analyses shall be attached to and become a part of the SSHP.

#### 1.11 STAFF ORGANIZATION, QUALIFICATIONS, AND RESPONSIBILITIES

An organizational structure shall be developed that sets forth lines of authority (chain of command), responsibilities, and communication procedures concerning site safety, health, and emergency response. This organizational structure shall cover management, supervisors and employees of the Contractor and subcontractors. The structure shall include the means for coordinating and controlling work activities of subcontractors and suppliers. The SSHP shall include a description of this organizational structure as well as qualifications and responsibilities of each of the following individuals. The Contractor shall obtain Contracting Officer's

acceptance before replacing any member of the Safety and Health Staff. Requests shall include the names, qualifications, duties, and responsibilities of each proposed replacement.

#### 1.11.1 Site Superintendent

A Site Superintendent, who has responsibility to implement the SSHP, the authority to direct work performed under this contract and verify compliance, shall be designated.

#### 1.11.2 Safety and Health Manager

##### 1.11.2.1 Qualifications

The services of an Industrial Hygienist certified by the American Board of Industrial Hygiene or a safety professional certified by the Board of Certified Safety Professionals shall be utilized. The name, qualifications (education summary and documentation, ABIH or BCSP certificate), and work experience summary shall be included in the SSHP. The Safety and Health Manager shall have the following additional qualifications:

a. A minimum of 3 years experience in developing and implementing safety and health programs either at hazardous waste sites, or in the hazardous waste disposal industry, or at underground storage tank removal projects.

b. Documented experience in supervising professional and technician level personnel.

c. Documented experience in developing worker exposure assessment programs and air monitoring programs and techniques.

d. Documented experience in the development of personal protective equipment programs, including programs for working in and around potentially toxic, flammable and combustible atmospheres and confined spaces.

e. Working knowledge of state and Federal occupational safety and health regulations.

##### 1.11.2.2 Responsibilities

The Safety and Health Manager shall:

a. Be responsible for the development, implementation, oversight, and enforcement of the SSHP.

b. Sign and date the SSHP prior to submittal.

c. Conduct initial site-specific training.

d. Be present onsite during the first 3 days of remedial activities and at the startup of each new major phase.

e. Visit the site as needed and at least once per week, or as directed by the Contracting Officer, for the duration of activities, to audit the effectiveness of the SSHP.

f. Be available for emergencies.

g. Provide onsite consultation as needed to ensure the SSHP is fully implemented.

h. Coordinate any modifications to the SSHP with the Site Superintendent, the SSHO, and the Contracting Officer.

i. Provide continued support for upgrading/downgrading of the level of personal protection.

j. Be responsible for evaluating air monitoring data and recommending changes to engineering controls, work practices, and PPE.

k. Review accident reports and results of daily inspections.

l. Serve as a member of the Contractor's quality control staff.

#### 1.11.3 Site Safety and Health Officer (SSHO)

##### 1.11.3.1 Qualifications of SSHO

An individual and 2 alternates shall be designated the Site Safety and Health Officer (SSHO). The name, qualifications (education and training summary and documentation), and work experience of the Site Safety and Health Officer and alternates shall be included in the SSHP. The SSHO shall have the following qualifications:

a. A minimum of 2 years experience in implementing safety and health programs either at hazardous waste sites, or in the hazardous waste disposal industry, or at underground storage tank removal projects where Level B personal protective equipment was required.

b. Documented experience in construction techniques and construction safety procedures.

c. Working knowledge of Federal and State of New York occupational safety and health regulations.

d. Specific training in personal and respiratory protective equipment program implementation, confined space program oversight, and in the proper use of air monitoring instruments, and air sampling methods including monitoring for ionizing radiation.

##### 1.11.3.2 Responsibilities of SSHO

The Site Safety and Health Officer shall:

a. Assist and represent the Safety and Health Manager in onsite training and the day to day onsite implementation and enforcement of the

accepted SSHP.

b. Be assigned to the site on a full time basis for the duration of field activities. The SSHO shall have no duties other than Safety and Health related duties. If operations are performed during more than 1 work shift per day, a site Safety and Health Officer shall be present for each shift.

c. Have authority to ensure site compliance with specified safety and health requirements, Federal, state and OSHA regulations and all aspects of the SSHP including, but not limited to, activity hazard analyses, air monitoring, use of PPE, decontamination, site control, standard operating procedures used to minimize hazards, safe use of engineering controls, the emergency response plan, confined space entry procedures, spill containment program, and preparation of records by performing a daily safety and health inspection and documenting results on the Daily Safety Inspection Log.

d. Have authority to stop work if unacceptable health or safety conditions exist, and take necessary action to re-establish and maintain safe working conditions.

e. Consult with and coordinate any modifications to the SSHP with the Safety and Health Manager, the Site Superintendent, and the Contracting Officer.

f. Serve as a member of the Contractor's quality control staff on matters relating to safety and health.

g. Conduct accident investigations and prepare accident reports.

h. Review results of daily quality control inspections and document safety and health findings into the Daily Safety Inspection Log.

i. In coordination with site management and the Safety and Health Manager, recommend corrective actions for identified deficiencies and oversee the corrective actions.

#### 1.11.4 Occupational Physician (OP)

##### 1.11.4.1 Qualifications of OP

The services of a licensed physician, who is certified in occupational medicine by the American Board of Preventative Medicine, or who, by necessary training and experience is Board eligible, shall be utilized. The physician shall be familiar with this site's hazards and the scope of this project. The medical consultant's name, qualifications, and knowledge of the site's conditions and proposed activities shall be included in the SSHP.

##### 1.11.4.2 Responsibilities of OP

The physician shall be responsible for the determination of medical surveillance protocols and for review of examination/test results performed in compliance with 29 CFR 1910, Section .120 (f) and 29 CFR 1926, Section

.65 (f) and paragraph MEDICAL SURVEILLANCE.

#### 1.11.5 Persons Certified in First Aid and CPR

At least two persons who are currently certified in first aid and CPR by the American Red Cross or other approved agency shall be onsite at all times during site operations. They shall be trained in universal precautions and the use of PPE as described in the Bloodborne Pathogens Standard of 29 CFR 1910, Section .1030. These persons may perform other duties but shall be immediately available to render first aid when needed.

#### 1.11.6 Safety and Health Technicians

For each work crew in the exclusion zone, one person, designated as a Safety and Health technician, shall perform activities such as air monitoring, decontamination, and safety oversight on behalf of the SSHO. They shall have appropriate training equivalent to the SSHO in each specific area for which they have responsibility and shall report to and be under the supervision of the SSHO.

#### 1.11.7 Certified Safety Professional (CSP)

The services of a safety professional certified by the Board of Certified Safety Professionals shall be utilized. The CSP shall report to the Safety and Health Manager. The CSP shall be responsible for assisting and, when necessary, substituting for the SHM.

### 1.12 TRAINING

Personnel shall receive training in accordance with the Contractor's written safety and health training program and 29 CFR 1910 Section .120, 29 CFR 1926 Section .65, and 29 CFR 1926 Section .21. The SSHP shall include a section describing training requirements.

#### 1.12.1 General Hazardous Waste Operations Training

Personnel entering the exclusion or contamination reduction zones shall have successfully completed 40 hours of hazardous waste instruction off the site; 3 days actual field experience under the direct supervision of a trained, experienced supervisor; and 8 hours refresher training annually. Onsite supervisors shall have completed the above training and 8 hours of additional, specialized training covering at least the following topics: the employer's safety and health program, personal protective equipment program, spill containment program, and health hazard monitoring procedures and techniques. Copies of current training certification statements shall be submitted prior to initial entry onto the work site.

#### 1.12.2 Site-specific Training

Site-specific training sessions shall be documented in accordance with Section 01.B.03.b of EM 385-1-1.

##### 1.12.2.1 Initial Session (Pre-entry Briefing)

Prior to commencement of onsite field activities, all site employees, including those assigned only to the Support Zone, shall attend a site-specific safety and health training session of at least 4 hours duration. This session shall be conducted by the Safety and Health Manager and the Site Safety and Health Officer to ensure that all personnel are familiar with requirements and responsibilities for maintaining a safe and healthful work environment. Procedures and contents of the accepted SSHP and Sections 01.B.02 and 28.D.03 of EM 385-1-1 shall be thoroughly discussed. The Contracting Officer shall be notified at least 5 days prior to the initial site-specific training session so government personnel involved in the project may attend.

#### 1.12.2.2 Periodic Sessions

Periodic onsite training shall be conducted by the SSHO or Safety and Health Manager at least weekly for personnel assigned to work at the site during the following week. The training shall address safety and health procedures, work practices, any changes in the SSHP, activity hazard analyses, work tasks, or schedule; results of previous week's air monitoring, review of safety discrepancies and accidents. Should an operational change affecting onsite field work be made, a meeting prior to implementation of the change shall be convened to explain safety and health procedures. Site-specific training sessions for new personnel, visitors, and suppliers shall be conducted by the SSHO using the training curriculum outlines developed by the Safety and Health Manager.

### 1.13 PERSONAL PROTECTIVE EQUIPMENT

#### 1.13.1 PPE Program

In accordance with 29 CFR 1910 Section .120 (g)(5) and 29 CFR 1926 Section .65 (g)(5), a written Personal Protective Equipment (PPE) program which addresses the elements listed in that regulation, and which complies with respiratory protection program requirements of 29 CFR 1910 Section .134, is to be included in the employer's Safety and Health Program. The Site Safety and Health Plan shall detail the minimum PPE ensembles (including respirators) and specific materials from which the PPE components are constructed for each site-specific task and operation to be performed, based upon the hazard/risk analysis. Components of levels of protection (B, C, D and modifications) must be relevant to site-specific conditions, including heat and cold stress potential and safety hazards. Only respirators approved by NIOSH shall be used. Onsite personnel shall be provided with appropriate personal protective equipment. Protective equipment and clothing shall be kept clean and well maintained. The PPE section of the SSHP shall include site-specific procedures to determine PPE program effectiveness and for onsite fit-testing of respirators, cleaning, maintenance, inspection, and storage of PPE.

#### 1.13.2 Levels of Protection

The Safety and Health Manager shall establish appropriate levels of protection for each work activity based on review of historical site information, existing data, an evaluation of the potential for exposure (inhalation, dermal, ingestion, and injection) during each task, past air

monitoring results, and a continuing safety and health monitoring program. The Safety and Health Manager shall also establish action levels for upgrade or downgrade in levels of PPE from the following specified minimum levels of protection. Protocols and the communication network for changing the level of protection shall be described in the SSHP. The PPE reassessment protocol shall address air monitoring results, potential for exposure, changes in site conditions, work phases, job tasks, weather, temperature extremes, individual medical considerations, etc.

#### 1.13.2.1 Components of Levels of Protection

The following items constitute minimum protective clothing and equipment ensembles to be utilized during this project:

##### Level D.

1. Coveralls.
2. Nitrile or neoprene gloves (when handling contaminated soil or water).
3. Boots/shoes, neoprene or rubber, steel toe and shank.
4. Safety glasses.
5. Hard hat

##### Modified Level D.

1. Full-face or half-mask air purifying respirators (NIOSH approved), ready to be donned as needed.
2. Saranex or polyethylene coated Tyvek coveralls. Coated coveralls must be worn when product quantities of fuel are encountered and when fuel saturated soil is handled.
3. Nitrile or neoprene gloves, outer.
4. Nitrile or neoprene gloves, inner.
5. Boots (outer), neoprene or rubber, steel toe and shank.
6. Boot covers, outer, disposable.
7. Hard hat.

##### Level C.

1. Full-face or half-mask air purifying respirators (NIOSH approved), donned.
2. Saranex or polyethylene coated Tyvek coveralls. Coated coveralls must be worn when product quantities of fuel are encountered and when fuel saturated soil is handled.
3. Nitrile or neoprene gloves, outer.
4. Nitrile or neoprene gloves, inner.
5. Boots (outer), neoprene or rubber, steel toe and shank.
6. Boot covers, outer, disposable.
7. Hard hat.

##### Level B.

1. Positive pressure, full-facepiece, self-contained breathing apparatus (SCBA) or positive pressure supplied air respirator

- with escape SCBA (NIOSH approved).
- 2. Saranex or polyethylene coated Tyvek coveralls. Coated coveralls must be worn when product quantities of fuel are encountered and when fuel saturated soil is handled.
- 3. Nitrile or neoprene gloves, outer.
- 4. Nitrile or neoprene gloves, inner.
- 5. Boots (outer), neoprene or rubber, steel toe and shank.
- 6. Boot covers, outer, disposable.
- 7. Hard hat.

#### 1.13.2.2 Initial Minimum Levels of PPE by Task

Based on available information, the initial minimum protective equipment requirements for each major task and operation are listed below. Available site information shall be reviewed and the list of tasks and operations and these levels of protection shall be expanded and/or revised during preparation of the SSHP.

#### MINIMUM PROTECTIVE EQUIPMENT REQUIREMENTS

TASK/OPERATION	INITIAL LEVEL OF PROTECTION
Site grubbing	Level D
Soil removal above the UST	Level D Modified
UST inerting	Level D Modified
UST removal	Level D Modified
Soil sampling	Level D Modified
UST cleaning and sludge removal	Level C
Site restoration	Level D
Tank entry/Confined space/Sludge removal	Level B

#### 1.13.3 PPE for Government Personnel

Three clean sets of personal protective equipment and personal dosimeters for work on radioactive waste cleanup sites and clothing (excluding air-purifying negative-pressure respirators and safety shoes, which will be provided by individual visitors), as required for entry into the Exclusion Zone and/or Contamination Reduction Zone, shall be available for use by the Contracting Officer or official visitors. The items shall be cleaned and maintained by the Contractor and stored in the clean room of the decontamination facility or together with the protective clothing used by the workers and clearly marked: "FOR USE BY GOVERNMENT ONLY." The Contractor shall provide basic training in the use and limitations of the PPE provided, and institute administrative controls to check prerequisites prior to issuance. Such prerequisites include meeting minimum training requirements for the work tasks to be performed and medical clearance for site hazards and respirator use.

#### 1.14 MEDICAL SURVEILLANCE

The Safety and Health Manager, in conjunction with the Occupational

Physician, shall detail, in the employer's Safety and Health Program and the SSHP, the medical surveillance program that includes scheduling of examinations, certification of fitness for duty, compliance with OSHA requirements, and information provided to the physician. Examinations shall be performed by or under the supervision of a licensed physician, preferably one knowledgeable in occupational medicine, and shall be provided without cost to the employee, without loss of pay and at a reasonable time and place. Medical surveillance protocols and examination and test results shall be reviewed by the Occupational Physician. The medical surveillance program shall contain the requirements specified below. Personnel working in contaminated areas of the site shall have been examined as prescribed in 29 CFR 1910 Section .120, and 29 CFR 1926 Section .65, and determined medically fit to perform their duties.

#### 1.14.1 Frequency of Examinations

Employees shall have been provided with medical examinations as specified, within the past 12 months and shall receive exams annually thereafter (if contract duration exceeds 1 year); on termination of employment; reassignment in accordance with 29 CFR 1910 Section .120 (f)(3)(i), and 29 CFR 1926 Section .65 (f)(3)(i)(C); if the employee develops signs or symptoms of illness related to workplace exposures; if the physician determines examinations need to be conducted more often than once a year; and when an employee develops a lost time injury or illness during the period of this contract. The supervisor shall be provided with a written statement signed by the physician prior to allowing the employee to return to the work site after injury or illness resulting in a lost workday, as defined in 29 CFR 1904 Section .12 (f).

#### 1.14.2 Content of Examinations

The following elements shall be included in the medical surveillance program. Additional elements may be included at the discretion of the occupational physician responsible for reviewing the medical surveillance protocols.

- a. Complete medical and occupational history (initial exam only).
- b. General physical examination of major organ systems.
- c. Pulmonary function testing including FVC and FEV1.0.
- d. CBC with differential.
- e. Blood chemistry screening profile (e.g. SMAC 20/25).
- f. Urinalysis with microscopic examination.
- g. Audiometric testing (as required by Hearing Conservation Program).
- h. Visual acuity.
- i. Chest x-ray. (This test shall be performed no more frequently than every 4 years, unless directed by Occupational Physician.)

- j. Electrocardiogram (as directed by Occupational Physician).
- k. Urine heavy metals (arsenic, cadmium, chromium, and mercury).
- l. serum lead.
- m. zinc protoporphyrin.

#### 1.14.3 Information Provided to the Occupational Physician

The physician shall be furnished with the following:

- a. Site information from paragraph, SITE DESCRIPTION AND CONTAMINATION CHARACTERIZATION.
- b. information on the employee's anticipated or measured exposure.
- c. a description of any PPE used or to be used.
- d. A description of the employee's duties as they relate to the employee's exposures (including physical demands on the employee and heat/cold stress).
- e. A copy of 29 CFR 1910 Section .120, or 29 CFR 1926 Section .65.
- f. Information from previous examinations not readily available to the examining physician.
- g. A copy of Section 5.0 of NIOSH Pub No. 85-115.
- h. Information required by 29 CFR 1910 Section .134.

#### 1.14.4 Physician's Written Opinion

Before work begins a copy of the physician's written opinion for each employee shall be obtained and furnished to the Safety and Health Manager; and the employee. The opinion shall address the employee's ability to perform hazardous remediation work and shall contain the following:

- a. The physician's recommended limitations upon the employee's assigned work and/or PPE usage.
- b. The physician's opinion about increased risk to the employee's health resulting from work; and
- c. A statement that the employee has been informed and advised about the results of the examination.

#### 1.14.5 Medical Records

Documentation of medical exams shall be provided as part of the Certificate of Worker or Visitor Acknowledgment. Medical records shall be maintained in accordance with 29 CFR 1910 Section .120, and 29 CFR 1926 Section .65.

#### 1.15 EXPOSURE MONITORING/AIR SAMPLING PROGRAM

The Safety and Health Manager shall prepare and implement an exposure monitoring/air sampling program to identify and quantify safety and health hazards and airborne levels of hazardous substances in order to assure proper selection of engineering controls, work practices and personal protective equipment for affected site personnel. Available site information shall be reviewed and the exposure monitoring/air sampling program shall be expanded and/or revised for submittal as part of the SSHP.

Minimum initial requirements for the program are delineated as per ACGIH Threshold Limits, 29 CFR 1910, EM 385-1-1 and NIOSH Pub No. 85-115.

#### 1.16 HEAT AND COLD STRESS MONITORING

The Safety and Health Manager shall develop a heat stress and cold stress monitoring program for onsite activities. Details of the monitoring program, including schedules for work and rest, and physiological monitoring requirements, shall be described in the SSHP. Personnel shall be trained to recognize the symptoms of heat and cold stress. The SSHP and an alternate person shall be designated, in writing, to be responsible for the heat and cold stress monitoring program.

##### 1.16.1 Heat Stress

Physiological monitoring shall commence when the ambient temperature is above 70 degrees F. Monitoring frequency shall increase as the ambient temperature increases or as slow recovery rates are observed. An adequate supply of cool drinking water shall be provided for the workers. NIOSH Pub No. 85-115 may be consulted for guidance in determining protocols for prevention of heat stress.

##### 1.16.2 Cold Stress

To guard against cold injury, appropriate clothing and warm shelter for rest periods shall be provided. Procedures to monitor and avoid cold stress shall be followed in accordance with the current TLVs for Cold Stress as recommended in ACGIH Threshold Limits.

#### 1.17 SAFETY PROCEDURES, ENGINEERING CONTROLS AND WORK PRACTICES

The SSHP shall describe the standard operating safety procedures, engineering controls and safe work practices to be implemented for the work covered. These shall include, but not be limited to, the following:

##### 1.17.1 General Site Rules/Prohibitions

General site rules/prohibitions (buddy system, eating, drinking, and smoking restrictions, etc.).

##### 1.17.2 Work Permit Requirements

Excavation, hot work, confined space, etc.

### 1.17.3 Material Handling Procedures

Soils, liquids.

#### 1.17.3.1 Spill and Discharge Control

Written spill and discharge containment/control procedures shall be developed and implemented. These procedures shall address radioactive wastes, shock sensitive wastes, laboratory waste packs, material handling equipment, and appropriate procedures for tank and vault entry as well as drum and container handling, opening, sampling, shipping and transport. These procedures shall describe prevention measures, such as building berms or dikes; spill control measures and material to be used (e.g. booms, vermiculite); location of the spill control material; personal protective equipment required to cleanup spills; disposal of contaminated material; and who is responsible to report the spill. Storage of contaminated material or hazardous materials shall be appropriately bermed, diked and/or contained to prevent any spillage of material on uncontaminated soil. If the spill or discharge is reportable, and/or human health or the environment are threatened, the National Response Center, the state, and the Contracting Officer shall be notified as soon as possible. Reporting requirements shall be in accordance with Section 02115 UNDERGROUND STORAGE TANK REMOVAL.

#### 1.17.3.2 Materials Transfer Safety

Liquids and residues shall be removed from the tanks using explosion-proof or air-driven pumps. Pump motors and suction hoses shall be bonded to the tank and grounded to prevent electrostatic ignition hazards. Use of a hand pump will be permitted to remove the last of the liquid from the bottom of the tanks. If a vacuum truck is used for removal of liquids or residues, the area of operation for the vacuum truck shall be vapor free. The truck shall be located upwind from the tank and outside the path of probable vapor travel. The vacuum pump exhaust gases shall be discharged through a hose of adequate size and length downwind of the truck and tank area. Vacuum truck operating and safety practices shall conform to API Publ 2219.

Tank residues shall be collected in drums, tanks, or tank trucks labeled according to 49 CFR 171 and 49 CFR 172 and disposed of as specified. After the materials have been transferred and the tanks have been exposed, fittings and lines leading to the tanks shall be disconnected and drained of their contents. The contents of the lines shall not spill to the environment during cutting or disconnecting of tank fittings. Materials drained shall be transferred into DOT-approved drums for storage and/or transportation. Only non-sparking or non-heat producing tools shall be used to disconnect and drain or to cut through tank fittings. Electrical equipment (e.g., pumps, portable hand tools, etc.) used for tank preparation shall be explosion-proof. Following cutting or disconnecting of the fittings, openings leading to the tanks shall be plugged.

#### 1.17.4 Drum and Container Handling

Procedures and Precautions (opening, sampling, overpacking).

#### 1.17.5 Confined Space Entry Procedures

Personnel shall not be permitted to enter confined spaces as a part of this project at any time until the provisions of 29 CFR 1910.146 are satisfied. The following requirements for entry into confined spaces shall also be enforced by the Contractor.

#### 1.17.5.1 Confined Space Permit

A confined space permit in compliance with 29 CFR 1910.146 shall be completed prior to any confined space entry. The permit shall be effective for a single shift.

#### 1.17.5.2 Safety Equipment

Appropriate Personal Protective Equipment, as outlined in the paragraph PERSONAL PROTECTIVE EQUIPMENT, as well as a safety harness and a lifeline shall be worn by all personnel entering the confined space. The lifeline shall be connected at all times to the personnel working within the confined space and to a location outside the confined space near the standby person.

#### 1.17.5.3 Air Monitoring

Monitoring for oxygen, combustible gases, and air toxics shall be conducted within the tanks prior to entry and continuously during work within the tanks. Levels above 10% LEL shall require immediate evacuation of personnel from the tank.

#### 1.17.5.4 Standby Person

A standby person shall be assigned to remain continuously on the outside of each confined space being entered and to be a constant contact (visual or verbal) with the worker(s) inside. The standby person shall have no duties other than to serve as standby and to know who should be notified in case of emergency. Standby personnel shall not enter a confined space in the event of an emergency until help arrives, and then only with the proper protective equipment and respirators and lifelines.

#### 1.17.5.5 Emergency Rescue Equipment

Two complete additional Level B ensembles shall be labelled and be readily available on site in the event that emergency rescue is required. These Level B ensembles shall be reserved solely for emergency rescue purposes, and be labelled as such.

#### 1.17.5.6 Emergency Lifelines

Lifelines, harnesses, and hoists shall be readily available on site in the event that emergency rescue is required.

#### 1.17.6 Hot Work

Hot work will not be permitted on or within the tanks except as outlined herein. Prior to conducting hot work, a hot work permit shall be prepared and submitted. An example format for a hot work permit shall be included in the SSHP. The permit shall describe compliance with the following procedures. After tank interiors have been decontaminated, hot work may be conducted only when the tank is inerted, and to the extent necessary to begin dismantling the tanks. After decontamination of tank interiors, hot work shall not be performed unless monitoring indicates atmospheres within and immediately surrounding the tanks are less than 8% oxygen inside the tank and less than 10% of the LFL outside the tank; continuous monitoring shall continue until the hot work is completed. The hot work prohibition includes welding, cutting, grinding, sawing, or other similar operations which could be expected to potentially generate combustion-producing temperatures or sparks, or which could produce potentially hazardous fumes or vapors. An individual at each hot work site shall be designated as a fire watch. This person's sole responsibility shall be to monitor the hot work and have immediate access to the fire extinguisher located at each hot work site. A new permit shall be obtained at the start of each work shift during which hot work will be conducted.

#### 1.17.7 Ignition Sources

Ignition sources, such as sparks producing equipment, shall not be permitted.

#### 1.17.8 Fire Protection and Prevention

Smoking and open flames are strictly prohibited at work sites. Work shall stop during electrical storms at the discretion of the SSO.

#### 1.17.9 Electrical Safety

If temporary electrical power is used for this project, it shall conform to the National Electrical Code, the National Electrical Safety Code, and EM 385-1-1. Where possible, motorized vehicles within the Exclusion Zone shall be grounded. Electrical equipment to be used on this project shall conform to EM 385-1-1. Air monitoring and sampling equipment shall be rated intrinsically safe for class I, Division I groups A, B, C, and D areas. All portable electrical equipment shall be protected by Ground Fault Circuit Interrupters (GFCI). Clearances to adjacent overhead transmission and distribution electrical lines shall be sufficient for the movement of vehicles and operation of construction equipment. The requirements stated in EM 385-1-1, 29 CFR 1926, and the National Electrical Safety Code shall be adhered to by the Contractor.

#### 1.17.10 Excavation and Trench Safety

All excavation work shall be conducted in strict conformance with EM 385-1-1 and 29 CFR, sections .650 through 653, including requirements for shoring or continuously sloping excavations in which employees are exposed to danger from moving ground. Prior to opening an excavation, underground installations (e.g. sewer, telephone, water, fuel, electrical lines) shall be located and protected from damage and displacement. Utility companies and other responsible authorities shall be contacted

to locate and mark the locations and direct or assist in protecting the underground installations.

#### 1.17.11 Guarding of Machinery and Equipment

In accordance with EM 385-1-1 and 29 CFR 1910 and 1926, machinery and equipment shall be installed and maintained where needed.

#### 1.17.12 Lockout/Tagout

In accordance with EM 385-1-1 and 29 CFR 1910 and 1926, a lockout/tagout program shall be developed.

#### 1.17.13 Fall Protection

In accordance with EM 385-1-1 and 29 CFR 1910 and 1926, fall protection equipment shall be utilized.

#### 1.17.14 Hazard Communication

In accordance with EM 385-1-1 and 29 CFR 1910 and 1926, a hazard communication program shall be established.

#### 1.17.15 Illumination

In accordance with EM 385-1-1 and 29 CFR 1910 and 1926, minimum illumination levels shall be maintained.

#### 1.17.16 Sanitation

In accordance with EM 385-1-1 and 29 CFR 1910 and 1926, adequate drinking water, toilets, and sanitary facilities shall be provided.

#### 1.17.17 Engineering Controls

In accordance with EM 385-1-1 and 29 CFR 1910 and 1926, engineering controls shall be utilized whenever possible before personnel are placed in PPE.

#### 1.17.18 Process Safety Management

In accordance with EM 385-1-1 and 29 CFR 1910 and 1926, appropriate process safety management procedures shall be followed.

#### 1.17.19 Signs and Labels

In accordance with EM 385-1-1 and 29 CFR 1910 and 1926, signs and labels shall be posted and be of appropriate color and size.

#### 1.17.20 Waste Disposal

Wastes shall be disposed of in accordance with EM 385-1-1 and 29 CFR 1910 and 1926, and State and local regulations.

## 1.17.21 Tank Purging for Permit-Required Confined Space Entries

Tanks shall be purged for confined space entry. The flammable vapors shall be reduced to less than 10% of the LFL and the oxygen content shall be between 19.5% and 23.5%. Confined space entry into the tanks shall not be attempted unless absolutely necessary, as for example, to remove sludge from the tank. Flammable vapors may be exhausted from the tank by any of the methods from API RP 1604 listed below, or any method approved by the Contracting Officer. The SSHP shall specify the purging method to be used.

a. Ventilation by Eductor-Type Air Movers: The eductor-type air mover shall be properly bonded and grounded to prevent the generation and discharge of static electricity. When using this method, the fill (drop) tube shall remain in place to ensure ventilation at the bottom of the tank.

Tanks equipped with fill (drop) tubes that are not removable shall be purged by this method. An eductor extension shall be used to discharge vapors a minimum of 12 feet above grade or 3 feet above adjacent roof lines, whichever is greater. If this is not possible, alternative methods shall be proposed and approved prior to purging. Noise levels generated by these devices as a result of high airflow may exceed OSHA PELs. Noise levels shall be evaluated and appropriate hearing protection shall be provided.

b. Ventilation by Diffused Air Blowers: When using this purging method, the air-diffusing pipe is properly bonded and grounded to prevent the discharge of a spark. Fill (drop) tubes shall be removed to allow proper diffusion of the air in the tank. Air supply shall be from a compressor that has been checked to ensure that Grade D breathing air is being supplied. Air pressure in the tank shall not exceed 5 psi gauge to avoid tank failure.

c. Commercial Emulsifiers and Volatile Fuel Encapsulators: These products are completely miscible in water, aid in the elimination of flammable vapors, and are biodegradable. Regulatory requirements for treatment and disposal of the water shall be determined prior to using this method. Standing outside the tank, the operator shall rinse the tank with a 3-to-6 percent solution of the product using a pressure sprayer through a tank opening. Explosive concentrations shall be measured at several levels (top, middle, and bottom) within the tank. If readings are greater than 10% of the LFL, the tank shall be rinsed again. When LFL readings are acceptable, the water in the tank shall be pumped out for disposal.

## 1.17.22 Tank Inerting (No Entry)

Following the removal of tank contents but prior to excavation of the tanks and tank preparation activities, the tanks shall be inerted only by introducing an inert gas, carbon dioxide (CO<sub>2</sub>) or liquid nitrogen (N<sub>2</sub>), to remove flammable vapors. Before inerting, all openings in the tanks shall be plugged with threaded or expansion type plugs except the vent tube and the opening to be used for introducing the inert gas. Within 30 minutes prior to initiating any activities (e.g., excavating, preparation, removal, opening, demolition, transportation, or other similar activities) involving a tank which has been inerted, the inerted nature of the tank (oxygen levels less than 8%) shall be verified.

a. CO2 fire extinguishers shall not be used for inerting the tank interiors. If a compressed gas (e.g., CO2 or N2) is introduced into the tank the following requirements shall be met to prevent the buildup of static electricity:

(1) The UST and the compressed gas supply tank shall be bonded together and grounded.

(2) The compressed gas shall be supplied only at low flows.

(3) The liquid or gas shall be released at the tank bottom so that static electricity is not generated by liquid falling to the bottom of the tank. The tank shall be slowly filled from the bottom up.

b. Dry ice, which evolves CO2 gas as it evaporates, if used, shall be introduced in the amount of at least 3 pounds per 100 gallons of tank capacity. Skin contact with dry ice shall be prevented by wearing heavy cloth gloves.

c. Sufficient quantities of inert gas (CO2 or N2) shall be introduced into the tanks to lower the oxygen content to less than 8%. Pressure inside the tank shall not exceed 5 psi. Prior to proceeding with additional activities on the tank (e.g., excavating), the oxygen content of the tanks shall be monitored to confirm that it is less than 8%. Additional oxygen level monitoring shall be conducted at least hourly while activities involving the tanks are underway but prior to decontamination of tank interiors; at least daily during periods in which the tanks are not being disturbed but prior to decontamination of their interiors; or as directed by the Contracting Officer. If monitoring of tank interiors indicates that oxygen levels are not remaining below 8%, additional inert gas shall be introduced and more frequent oxygen monitoring shall be initiated.

d. During inerting procedures, an extension vent tube a minimum of 12 feet above grade or 3 feet above any adjacent (within 75 feet) roof lines, whichever is greater shall be used to discharge tank vapors. If this is not possible, alternative methods shall be proposed and approved prior to inerting. Continuous combustible gas/oxygen monitoring shall be conducted at the vent and inert gas introduction holes.

#### 1.17.23 Tank Atmosphere Testing

The air within the storage tanks shall be monitored to ensure the space is either adequately purged and safe for personnel entry, or to ensure the tank has been adequately inerted and the oxygen content is less than 8%. In both instances, monitoring shall be performed at the top, bottom, and middle areas of the tanks to ensure stratification has not occurred. Monitoring results shall be reported to project personnel to ensure safe operations. Data shall be recorded as specified in paragraph EXPOSURE MONITORING/AIR SAMPLING PROGRAM.

##### 1.17.23.1 Monitoring to Ensure Purging

When monitoring to ensure purging, both oxygen content and LFL readings are required. Prior to obtaining LFL readings, the Contractor shall monitor the oxygen content of the space and verify that the combustible gas indicators are operating within the oxygen limits identified by the CGI manufacturer. Personnel shall not be permitted to enter spaces with oxygen levels less than 19.5%, except in emergencies, and then only when equipped with the proper PPE and when following permit-required confined space entry procedures. Toxic air contaminants shall be monitored as specified in paragraph EXPOSURE MONITORING/AIR SAMPLING PROGRAM.

#### 1.17.23.2 Monitoring to Ensure Inerting

Inerted tanks shall be monitored to ensure oxygen readings remain below a maximum allowable percentage of 8% by volume.

#### 1.17.24 Tank Lifting

Tanks shall be lifted using equipment with a rated capacity greater than the load to be lifted. Tanks shall be lifted by lifting eyes or by straps under the ends of the tanks. Tanks shall not be lifted by the manhole flange or by removing the bungs. Personnel shall be directed to remain away from the ends of the tanks and tanks shall be positioned, whenever possible, with the ends oriented away from occupied or traveled areas, due to potential for rupture. During transportation, the tanks shall be secured to prevent movement.

#### 1.17.25 Tank Demolition

The tanks excavated as part of this project shall be demolished before being removed from the site unless they are transported directly to a state certified tank destruction facility. Demolition will not be permitted until a decontamination of the interiors and exteriors is complete. Demolition shall involve opening the tanks sufficiently to permanently prohibit further use as containers of liquids. Tanks shall be inerted and tested before they are opened. Plans and procedures, including a list of materials and supplies, for safely and effectively demolishing the tanks shall be submitted in the SSHP.

#### 1.17.26 Tank Cleaning

Safety practices and procedures for the cleaning of the storage tanks shall conform to API Std 2015. Opening of the tanks to permit decontamination shall be conducted utilizing only methods approved in the SSHP. The interior and exterior of the tank shall be decontaminated prior to removing it from the work site unless the tank is being transported directly to a state certified tank destruction facility. Plans and procedures, including materials and supplies, for safely and effectively opening the tanks, cleaning surfaces of the interior and exterior of the tanks, and disposing of the decontamination fluids shall be submitted in the SSHP. Volatile organic solvents shall not be permitted to be utilized for decontamination procedures. Personnel shall not enter any of the storage tanks as a part of this project, except when following permit-required confined space entry procedures. Decontamination fluids shall be collected and disposed. Upon completion of this project, written certification shall be made that the

tank was properly decontaminated prior to being removed from the site.

#### 1.18 SITE CONTROL MEASURES

In order to prevent the spread of contamination and control the flow of personnel, vehicles, and materials into and out of work areas, site control measures shall be established and described in the SSHP. The SSHP shall describe the methodology to be used by the Safety and Health Manager and SSHO in determining work zone designations and their modifications, and procedures to limit the spread of contamination. The SSHP shall include procedures for the implementation and enforcement of safety and health rules for all persons on the site, including employers, employees, outside Contractors, government representatives, and visitors.

##### 1.18.1 Work Zones

Initial anticipated work zone boundaries are shown on the drawings. Utilizing this guidance, work zone boundaries (exclusion zone, including restricted and regulated areas; contamination reduction zone; and support zone) and access points shall be established and the boundary delineations shall be included on the drawings and in the SSHP. Delineation of work zone boundaries shall be based on the contamination characterization data and the hazard/risk analysis to be performed as described in paragraph: HAZARD/RISK ANALYSIS. As work progresses and field conditions are monitored, work zone boundaries may be modified with approval of the Contracting Officer. Work zones shall be clearly identified and marked in the field (using fences, tape, signs, etc.). A site map, showing work zone boundaries and locations of decontamination facilities, shall be posted in the onsite office. Work zones shall consist of the following:

a. Exclusion Zone (EZ): The exclusion zone is the area where hazardous contamination is either known or expected to occur and the greatest potential for exposure exists. Entry into this area shall be controlled and exit may only be made through the CRZ.

b. Contamination Reduction Zone (CRZ): The CRZ is the transition area between the Exclusion Zone and the Support Zone. The personnel and equipment decontamination areas shall be separate and unique areas located in the CRZ.

c. Support Zone (SZ): The Support Zone is defined as areas of the site, other than exclusion zones and contamination reduction zones, where workers do not have the potential to be exposed to hazardous substances or dangerous conditions resulting from hazardous waste operations. The Support Zone shall be secured against active or passive contamination. Site offices, parking areas, and other support facilities shall be located in the Support Zone.

##### 1.18.2 Site Control Log

A log of personnel visiting, entering, or working on the site shall be maintained. The log shall include the following: date, name, agency or company, time entering and exiting site, time entering and exiting the exclusion zone (if applicable), and personal protective equipment utilized.

Before visitors are allowed to enter the Contamination Reduction Zone or Exclusion Zone, they shall show proof of current training, medical surveillance and respirator fit testing (if respirators are required for the tasks to be performed) and shall fill out the Certificate of Worker or Visitor Acknowledgment. This visitor information, including date, shall be recorded in the log.

#### 1.18.3 Communication

An employee alarm system that has adequate means of on and off site communication shall be provided and installed in accordance with 29 CFR 1910 Section .165. The means of communication shall be able to be perceived above ambient noise or light levels by employees in the affected portions of the workplace. The signals shall be distinctive and recognizable as messages to evacuate or to perform critical operations.

#### 1.18.4 Site Security

The following site security shall be provided: Warning signs, a security fence and access procedures. Signs shall be printed in bold large letters on contrasting backgrounds in English and/or where appropriate, in the predominant language of workers unable to read English. Signs shall be visible from all points where entry might occur and at such distances from the restricted area that employees may read the signs and take necessary protective steps before entering.

### 1.19 PERSONAL HYGIENE AND DECONTAMINATION

Personnel entering the Exclusion or Contamination Reduction Zones or otherwise exposed or subject to exposure to hazardous chemical vapors, liquids, or contaminated solids shall adhere to the following personal hygiene and decontamination provisions. Decontamination shall be performed in the CRZ prior to entering the Support Zone from the Exclusion Zone. Chapter 10.0 of NIOSH Pub No. 85-115 shall be consulted when preparing decontamination procedures. A detailed discussion of personal hygiene and decontamination facilities and procedures to be followed by site workers shall be submitted as part of the SSHP. Employees shall be trained in the procedures and the procedures shall be enforced throughout site operations.

Persons disregarding these provisions of the SSHP shall be barred from the site.

#### 1.19.1 Personnel Decontamination Facilities

The following facilities shall be provided: 1) A personnel decontamination facility in the CRZ. This facility shall be used by both Contractor personnel and government representatives. The decontamination facility shall provide for separation of street clothing and contaminated PPE and shall be equipped with heating, lighting, ventilation, a change room and lockers, hot and cold water, shower facilities with hot and cold water, towels, soap in sufficient quantities for all anticipated personnel, and waste water storage facilities for controlling the disposal of used water. 2) Laundry facilities or provisions of laundry service. If an offsite laundry service is used, they shall be notified, in writing, of the possibility and nature of contaminants expected on clothing.

### 1.19.2 Procedures

Minimum decontamination procedures are listed below. Available site information shall be reviewed and these procedures shall be expanded and/or revised for submittal as part of the SSHP.

### 1.20 EQUIPMENT DECONTAMINATION

Vehicles and equipment used in the EZ shall be decontaminated in the CRZ prior to leaving the site. The procedures for decontamination of vehicles and equipment shall be addressed in the SSHP.

#### 1.20.1 Equipment Decontamination Facilities

A vehicle/equipment decontamination station shall be provided within the CRZ for decontaminating vehicles and equipment leaving the EZ. The decontamination station shall include the following: A traffic surface consisting of a minimum of 12 inches of crushed rock. The crushed rock shall be underlaid by a chemically resistant impermeable flexible membrane, such as HDPE, PVC or VLDPE with a minimum thickness of [40][\_\_\_\_\_] mils. The liner shall be protected from damage on top with a geotextile. The base layer of soil on which the membrane is placed shall be free of objects greater than [0.375][\_\_\_\_\_] inches in diameter and any other materials which could puncture or damage the membrane. The pad shall be constructed to capture decontamination water, including overspray, and shall allow for collection and removal of the decontamination water using sumps, dikes and ditches as required. High pressure, low volume, water wash area for equipment and vehicles. A steam cleaning system for use after the mud and/or site material has been cleaned from the equipment. A designated "clean area" in the CRZ for performing equipment maintenance. This area shall be used when personnel are required by normal practices to come in contact with the ground, i.e., crawling under a vehicle to change engine oil. Equipment within the EZ or CRZ shall be decontaminated before maintenance is performed.

#### 1.20.2 Procedures

Procedures for equipment decontamination shall be developed and utilized to prevent the spread of contamination into the SZ and offsite areas. These procedures shall address disposal of contaminated products and spent materials used on the site, including containers, fluids, oils, etc. Any item taken into the EZ shall be assumed to be contaminated and shall be inspected and/or decontaminated before the item leaves the area. Vehicles, equipment, and materials shall be cleaned and decontaminated prior to leaving the site. Construction material shall be handled in such a way as to minimize the potential for contaminants being spread and/or carried offsite. Prior to exiting the site, vehicles and equipment shall be monitored to ensure the adequacy of decontamination.

### 1.21 EMERGENCY EQUIPMENT AND FIRST AID REQUIREMENTS

The SSHP shall describe the emergency and first aid equipment to be available onsite. The following items, as a minimum, shall be maintained

onsite and available for immediate use:

- a. First aid equipment and supplies approved by the consulting physician.
- b. Emergency eyewashes and showers which comply with ANSI Z358.1.
- c. Emergency-use respirators. For escape purposes, 5- to 15-minute emergency escape masks shall be supplied. For rescue purposes, 2 positive pressure self-contained breathing apparatus (SCBA) shall be supplied. These shall be dedicated for emergency use only and maintained onsite in the Contamination Reduction Zone.
- d. Fire extinguishers with a minimum rating of 20-A:120-B:C shall be provided at site facilities and in all vehicles and at any other site locations where flammable or combustible materials present a fire risk.

#### 1.22 EMERGENCY RESPONSE AND CONTINGENCY PROCEDURES

An Emergency Response Plan, that meets the requirements of 29 CFR 1910 Section .120 (1) and 29 CFR 1926 Section .65 (1), shall be developed and implemented as a section of the SSHP. In the event of any emergency associated with remedial action, the Contractor shall, without delay, alert all onsite employees that there is an emergency situation; take action to remove or otherwise minimize the cause of the emergency; alert the Contracting Officer; and institute measures necessary to prevent repetition of the conditions or actions leading to, or resulting in, the emergency. Employees that are required to respond to hazardous emergency situations shall be trained in how to respond to such expected emergencies. The plan shall be rehearsed regularly as part of the overall training program for site operations. The plan shall be reviewed periodically and revised as necessary to reflect new or changing site conditions or information. Copies of the accepted SSHP and revisions shall be provided to the affected local emergency response agencies. The following elements, as a minimum, shall be addressed in the plan:

- a. Pre-emergency planning. The local emergency response agencies shall be contacted and met with during preparation of the Emergency Response Plan. Agencies to be contacted include local fire, police, and rescue authorities with jurisdiction and nearby medical facilities that may be utilized for emergency treatment of injured personnel. At these meetings, the agencies shall be notified of upcoming site activities and potential emergency situations. The response agencies' capabilities shall be ascertained and written response commitments obtained. The Contractor shall ensure the Emergency Response Plan for the site is compatible and integrated with the disaster, fire and/or emergency response plans of local, state, and Federal agencies.
- b. Personnel roles, lines of authority, communications for emergencies.
- c. Emergency recognition and prevention.

d. Site topography, layout, and prevailing weather conditions.

e. Criteria and procedures for site evacuation (emergency alerting procedures, employee alarm system, emergency PPE and equipment, safe distances, places of refuge, evacuation routes, site security and control).

f. Specific procedures for decontamination and medical treatment of injured personnel.

g. Route maps to nearest prenotified medical facility. Site-support vehicles shall be equipped with maps. At the beginning of project operations, drivers of the support vehicles shall become familiar with the emergency route and the travel time required.

h. Emergency alerting and response procedures including posted instructions and a list of names and telephone numbers of emergency contacts (physician, nearby medical facility, fire and police departments, ambulance service, Federal, state, and local environmental agencies; as well as Safety and Health Manager, the Site Superintendent, the Contracting Officer and/or their alternates).

i. Criteria for initiating community alert program, contacts, and responsibilities.

j. Procedures for reporting incidents to appropriate government agencies. In the event that an incident such as an explosion or fire, or a spill or release of toxic materials occurs during the course of the project, the appropriate government agencies shall be immediately notified.

In addition, the Contracting Officer shall be verbally notified immediately and receive a written notification within 24 hours. The report shall include the following items:

(1) Name, organization, telephone number, and location of the Contractor.

(2) Name and title of the person(s) reporting.

(3) Date and time of the incident.

(4) Location of the incident, i.e., site location, facility name.

(5) Brief summary of the incident giving pertinent details including type of operation ongoing at the time of the incident.

(6) Cause of the incident, if known.

(7) Casualties (fatalities, disabling injuries).

(8) Details of any existing chemical hazard or contamination.

(9) Estimated property damage, if applicable.

(10) Nature of damage, effect on contract schedule.

(11) Action taken to ensure safety and security.

(12) Other damage or injuries sustained, public or private.

k. Procedures for critique of emergency responses and follow-up.

#### 1.23 CERTIFICATE OF WORKER/VISITOR ACKNOWLEDGEMENT

A copy of a Contractor-generated certificate of worker/visitor acknowledgement shall be completed and submitted for each visitor allowed to enter contamination reduction or exclusion zones, and for each employee, following the example certificate at the end of this section.

#### 1.24 INSPECTIONS

The SSHO shall perform daily inspections of the jobsite and the work in progress to ensure compliance with EM 385-1-1, the Safety and Health Program, the SSHP and other occupational health and safety requirements of the contract, and to determine the effectiveness of the SSHP. Procedures for correcting deficiencies (including actions, timetable and responsibilities) shall be described in the SSHP. Follow-up inspections to ensure correction of deficiencies shall be conducted and documented. Daily safety inspection logs shall be used to document the inspections, noting safety and health deficiencies, deficiencies in the effectiveness of the SSHP, and corrective actions taken. The SSHO's Daily Inspection Logs shall be attached to and submitted with the Daily Quality Control reports. Each entry shall include the following: date, work area checked, employees present in work area, PPE and work equipment being used in each area, special safety and health issues and notes, and signature of preparer. In the event of an accident, the Contracting Officer shall be notified according to EM 385-1-1. Within 2 working days of any reportable accident, an Accident Report shall be completed on ENG Form 3394 and submitted.

#### 1.25 SAFETY AND HEALTH PHASE-OUT REPORT

A Safety and Health Phase-Out Report shall be submitted within 10 working days following completion of the work, prior to final acceptance of the work. The following minimum information shall be included:

a. Summary of the overall performance of safety and health (accidents or incidents including near misses, unusual events, lessons learned, etc.).

b. Final decontamination documentation including procedures and techniques used to decontaminate equipment, vehicles, and on site facilities.

c. Summary of exposure monitoring and air sampling accomplished during the project.

d. Signatures of Safety and Health Manager and SSHO.

## EXAMPLE CERTIFICATE OF WORKER/VISITOR ACKNOWLEDGMENT

PROJECT NAME \_\_\_\_\_ CONTRACT NO. \_\_\_\_\_  
 PROJECT ADDRESS \_\_\_\_\_  
 CONTRACTOR'S NAME \_\_\_\_\_  
 EMPLOYEE'S or VISITOR'S NAME \_\_\_\_\_

The contract for the above project requires the following: that you be provided with and complete formal and site-specific training; that you be supplied with proper personal protective equipment including respirators; that you be trained in its use; and that you receive a medical examination to evaluate your physical capacity to perform your assigned work tasks, under the environmental conditions expected, while wearing the required personal protective equipment. These things are to be done at no cost to you. By signing this certification, you are acknowledging that your employer has met these obligations to you.

I HAVE READ, UNDERSTAND AND AGREE TO FOLLOW THE SITE SAFETY AND HEALTH PLAN FOR THIS SITE.

Name \_\_\_\_\_ Date \_\_\_\_\_

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 FORMAL TRAINING: I have completed the following formal training courses that meet OSHA's requirements:

Date Completed

40 hour: .....  
 8 hour supervisory:.....  
 8 hour refresher:.....

SITE-SPECIFIC TRAINING: I have been provided and have completed the site-specific training required by this Contract. The Site Safety and Health Officer conducted the training. \_\_\_\_\_

RESPIRATORY PROTECTION: I have been trained in accordance with the criteria in [the Contractor's] [my Employer's] Respiratory Protection program. I have been trained in the proper work procedures and use and limitations of the respirator(s) I will wear. I have been trained in and will abide by the facial hair policy. \_\_\_\_\_

RESPIRATOR FIT-TEST TRAINING: I have been trained in the proper selection, fit, use, care, cleaning, and maintenance, and storage of the respirator(s) that I will wear. I have been fit-tested in accordance with the criteria in [the Contractor's] [my employer's] Respiratory Program and have received a satisfactory fit. [I have been assigned my individual respirator.] I have been taught how to properly perform positive and negative pressure fit-check upon donning negative pressure respirators each time. \_\_\_\_\_

MEDICAL EXAMINATION: I have had a medical examination within the last twelve months which was paid for by my employer. The examination included: health history, pulmonary function tests and may have included an evaluation of a chest ax-ray. A physician made determination regarding my physical capacity to perform work tasks on the project while wearing protective equipment including a respirator. I was personally provided a copy and informed of the results of that examination. My employer's industrial hygienist evaluated the medical certification provided by the physician and checked the appropriate blank below. The physician determined that there:

were no limitations to performing the required work tasks;

were identified physical limitations to performing the required work tasks.

Date medical exam completed

[Employee's][Visitor's] Signature \_\_\_\_\_  
Date \_\_\_\_\_

Printed Name \_\_\_\_\_

Social Security Number \_\_\_\_\_

Contractor's Site Safety and Health Officer Signature \_\_\_\_\_

Date \_\_\_\_\_

Printed Name \_\_\_\_\_

Social Security Number \_\_\_\_\_

PART 2 PRODUCTS (Not Applicable)

PART 3 EXECUTION (Not Applicable)

-- End of Section --

## SECTION 01450

CHEMICAL DATA QUALITY CONTROL  
10/97

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

## CODE OF FEDERAL REGULATIONS (CFR)

40 CFR 261	Identification and Listing of Hazardous Waste
40 CFR 262	Standards Applicable to Generators of Hazardous Waste
40 CFR 268	Land Disposal Restrictions
49 CFR 172	Hazardous Material Table, Special Provisions, Hazardous Material Communications, Emergency Response Information, and Training Requirements
49 CFR 178	Specifications for Packaging

## U.S. ARMY CORPS OF ENGINEER MANUAL (EM)

EM 200-1-1	(1994) Validation of Analytical Chemistry Laboratories
EM 200-1-3	(1994) Requirements for the Preparation of Sampling and Analysis Plans Ch 1
EM 200-1-6	(1997) Chemical Quality Assurance

## U.S. ARMY CORPS OF ENGINEERS ENGINEER MANUAL (ER)

ER 1110-1-263	(1996) Data Quality Management for Hazardous, Toxic, Radioactive Waste Remedial Activities
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## ENVIRONMENTAL PROTECTION AGENCY (EPA)

EPA 540/R 94-012	(1994) Contract Laboratory Program National Functional Guidelines for Inorganic Data Review
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EPA 540/R 94-013 (1994) Contract Laboratory Program  
National Functional Guidelines for Organic  
Data Review

EPA SW-846 (Rev O; updates I, II, IIA, IIB, and III)  
Test Methods for Evaluating Solid Waste  
(Vol IA, IB, IC, and II)

U.S. ARMY ENVIRONMENTAL HYGIENE AGENCY (USAEHA)

USAEHA-01 (1993) Sampling Protocol Building  
Demolition Debris and Buildings Painted  
with Lead-Based Paint

## 1.2 ACRONYMS

The definition of acronyms used by the Contractor that pertain to chemical data quality control shall be clearly defined for all contract related products and communications. The following acronyms are included in this section:

CDFR - Chemical Data Final Report  
CDQC - Chemical Data Quality Control  
CO - Contracting Officer  
CQAR - Chemical Quality Assurance Report  
CQC - Contractor Quality Control  
DA - Design Analysis  
DQO - Data Quality Objectives  
FSP - Field Sampling Plan  
PE - Performance Evaluation  
QA - Quality Assurance  
QAPP - Quality Assurance Project Plan  
QALAN - Quality Assurance Laboratory Advance Notification  
SAP - Sampling and Analysis Plan

## 1.3 MEASUREMENT AND PAYMENT

Separate payment will not be made for providing and maintaining the chemical data quality requirements including the chemical data quality management, chemical data validation, minimum chemical data reporting requirements, and chemical data quality submittal requirements; these costs shall be included in the applicable unit prices or lump sum prices contained in the bidding schedule.

## 1.4 CHEMISTRY REQUIREMENTS

Chemical Data Quality Control (CDQC) shall be as defined in ER 1110-1-263; this ER, which integrates USACE guidance on the subject, shall be supplemented by EM 200-1-6 for detail technical guidance on CDQC. Tables and charts defining Design Analysis (DA), ROD, and remedial technology specific chemistry shall be according to or consistent with EM 200-1-3.

Chemical analyses shall include, but not be limited to, the following:

Arsenic, Barium, Benzene, Cadmium, Carbon Tetrachloride, Chlordane, Chlorobenzene, Chloroform, Chromium, Cresols, 2,4-D, 1,4-Dichlorobenzene, 1,2-Dichloroethane, 1,1-Dichloroethylene, 2,4-Dinitrotoluene, Endrin, Heptachlors, Hexachlorobenzene, Hexachloro-1, 3-butadiene, Hexachloroethane, Lead, Lindane, Mercury, Metocychlor, Methyl ethyl ketone, Nitrobenzene, Penrachlorophenol, Pyridine, Selenium, Silver, Tetrachloroethylene, Toxaphene, Trichloroethylene, Trichlorophenols, Silvex, and Vinyl chloride.

#### 1.4.1 Site History

Site history is given in Section 01000 SCOPE OF WORK

#### 1.4.2 Data Quality Objectives (DQO)

Sample acquisition, chemical analysis and chemical parameter measurements shall be performed so that the resulting data meet and support data use requirements. The chemical data shall be acquired, documented, verified and reported to ensure that the specified precision, accuracy, representativeness, comparability, completeness and sensitivity requirements are achieved.

#### 1.4.3 Sampling, Analysis and Measurement

##### 1.4.3.1 Soil/Sediment and Ground/Surface Water Samples

Soil/sediment and ground/surface water samples shall be collected and analyzed and/or shipped to a primary laboratory as per Section 02111 EXCAVATION AND HANDLING OF CONTAMINATED MATERIAL.

##### 1.4.3.2 Manifesting Samples

Material shipping manifesting shall be in accordance with 40 CFR 261, 40 CFR 262, 40 CFR 268, 49 CFR 172, and 49 CFR 178 and Section 02120 TRANSPORTATION AND DISPOSAL OF HAZARDOUS MATERIALS.

##### 1.4.3.3 Field Screening

Field screening shall include photoionization detector, field gas chromatography, or similar methods.

#### 1.5 QUALITY ASSURANCE ELEMENTS

The Contractor shall be responsible for the following QA elements necessary to monitor and ensure the quality of chemical data produced.

##### 1.5.1 Laboratory Validation Requirements

The Contractor shall propose the minimum number of laboratories that can attain or have attained U.S. Army Corps of Engineers (USACE) validation in accordance with EM 200-1-1 and consistent with contract required chemical data quality. The Contractor may propose laboratories that shall subsequently be validated by the USACE, or select currently validated USACE

laboratories. The Contractor shall identify all proposed project laboratories in the sampling and analysis plan (SAP). If a proposed analytical laboratory cannot meet specified analytical requirements or achieve the required validation, the Contractor shall select another laboratory. The Contractor is advised that if not currently validated, the USACE laboratory validation process requires a nominal 120 days to process.

#### 1.5.2 Quality Assurance Sample Collection and Analysis

The Contractor shall be responsible for collection and transportation of QA samples to the QA laboratory. Samples for all analyses (except volatiles) shall be taken as splits of homogenized samples. Samples for volatiles shall be collected as discrete duplicates/triplicates. QA samples shall be collected at a rate of 10 percent or a minimum of 2 samples per matrix per analysis per sampling event.

- a. The Contractor shall submit the QA Laboratory Advance Notification (QALAN) to the QA laboratory. The QALAN shall include a list of laboratory-related DQO. The DQO shall include, but shall not be limited to, identification of extraction and analysis method numbers, a list of analytes with required limits, estimated number of tests, approximate sampling dates, and requested completion date for QA testing. The Contractor shall notify the Contracting Officer (CO) and the QA laboratory immediately of any changes.
- b. The Contractor shall provide all labor and field supplies, including sample containers and shipping coolers, for collecting and shipping samples for QA testing. The Contractor shall, in the presence of the CO, properly collect, label, and package the QA samples, fill out all chain-of-custody forms, and ship the samples by one-day delivery service to the designated QA laboratory for analysis. The Contractor shall notify the laboratory when all sampling is completed and shall clearly mark the chain-of-custody form accompanying the final shipment "FINAL" in 1 inch high lettering.
- c. The Contractor shall allow 60 calendar days for laboratory analysis of QA samples, data review, and submission of the Government chemical quality assurance report. The elapsed time shall begin when the Contractor's last sample arrives at the QA laboratory, provided that the Contractor's completed chemistry data package is received within 30 calendar days thereafter. Otherwise, the Contractor shall allow 30 calendar days from the date the completed chemistry data package is received at the laboratory. Where QA results are unacceptable due to Contractor negligence (e.g. improper sample collection and/or handling by the Contractor), or where QA sample results conflict with the Contractor's primary sample results, further sampling and testing shall be performed as directed by the CO. All costs for such additional sampling and testing due to Contractor negligence, including both QC and QA testing and analysis, and for any required remedial actions in the work, shall be borne by the Contractor. USACE acceptance of final disposition of any excavated soil shall not occur until the Contractor's sampling and

QC results have been confirmed by QA results. This includes all final stockpiling, wasting, backfilling, and related construction.

No payment will be made for laboratory sampling and testing before receipt and acceptance by the Government of the QA samples and the completed Chemical Data Final Report (CDFR), properly formulated according to these specifications.

#### 1.5.3 Single or Double Blind Performance Evaluation Samples

The Contractor shall submit certified soil and water Performance Evaluation (PE) samples. The PE samples shall contain the site specific contaminants of concern. The analytes shall be contained in the PE samples at the site specific action levels for each target analyte. Throughout the duration of the project 2 samples per analysis type shall be submitted for analysis. At least 2 samples shall be submitted during the first week of analysis so that the Contractor can assess the quality of the laboratory data. If the laboratory does not meet the certified PE sample acceptance limits, project sample analysis shall be terminated until corrective actions have been implemented. The Contractor shall supply the PE sample results and the vendor's acceptance limit documentation to the CO within 2 working days following reporting of the results by the laboratory.

#### 1.5.4 Review of Primary Laboratory Data

The Contractor shall be responsible for the independent data review of the entire primary data set.

#### 1.5.5 Validation of Data

The Contractor shall be responsible for validating 10 percent of the data in accordance with EPA 540/R 94-012 and EPA 540/R 94-013. The data validation strategy shall be established at the beginning of the project to be consistent with project DQO.

### 1.6 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

#### SD-01 Data

Sampling and Analysis Plan; G, RE.

The SAP including the Field Sampling Plan (FSP) and the Quality Assurance Project Plan (QAPP), no later than 30 days after receipt of notice to proceed.

#### SD-09 Reports

Quality Assurance Sample Collection and Analysis; G, RE

The QA Laboratory Advance Notification (QALAN); it shall be provided to the QA laboratory at least 10 business days before the initial shipment of samples.

Chemistry Data Package; FIO

The chemistry data package; it shall be provided as an attachment to the CDFR.

Chemical Data Final Report; G, RE.

The CDFR shall be submitted within 30 days of completing work at the site, before final payment. Each report shall be labeled with the contract number, project name and location.

## 1.7 QUALIFICATIONS

### 1.7.1 Chemical Quality Control Officer

As a minimum, the Contractor's Chemical Quality Control Officer shall have:  
a Bachelor's degree in Chemistry; 2 years of experience related to investigations, studies, design and remedial actions at HTRW sites; and 2 field seasons (or one continuous calendar year experience) in calibration and operation of various field monitoring devices as well as standard analytical chemistry methods common for analyzing soil, water, air and other materials for chemical contamination assessment, including hazardous waste manifesting. The Chemical Quality Control Officer shall ensure that all chemistry related objectives including responsibilities for DQO definitions, sampling and analysis, project requirements for data documentation and validation, and final project reports are attained. The Chemical Quality Control officer need not be present onsite during routine sampling, but shall be available for consultation with Government and Contractor personnel.

The Chemical Quality Control Officer, at the Contractor's option, shall train Contractor assigned staff in the requirements of sampling and performing field analyses in accordance with the requirements of this section. the performance of field analyses and the STADD assigned to this task shall be subject to approval by the Contracting Officer. If, in the sole opinion of the CO, the field analyses do not meet establish criteria, the Contractor shall be required to have the Contractor's primary laboratory perform all analyses.

## 1.8 COORDINATION MEETING

After the preconstruction conference, before any sampling or testing, the Contractor and the Contracting Officer will meet at the construction site or at other mutually convenient location to discuss the CQC Plan and the SAP. The coordination meeting will be simultaneous to any CQC coordination meeting required in Section 01451 CONTRACTOR QUALITY CONTROL unless otherwise indicated or directed. A list of definable features that involve chemical measurements shall be agreed upon. At a minimum, each matrix (soil, water, air, containerized wastes, radioactive wastes, instrumental chemical parameter measurement, etc.) shall be a definable work feature.

Management of the chemical data quality system including project DQO, project submittals, chemical data documentation, chemical data assessment, required sampling and analysis protocols, and minimum data reporting requirements shall be agreed upon. The meeting will serve to establish an interrelationship between the Contractor's chemical data quality management and Government chemical quality assurance requirements. Minutes of the meeting will be documented by the Government and shall be signed by both the Contractor and the Contracting Officer. The minutes will include any or all unresolved chemical issues along with the conditions for resolution and will become a part of the contract file.

## PART 2 PRODUCTS (NOT APPLICABLE)

## PART 3 EXECUTION

### 3.1 GENERAL REQUIREMENTS

The Contractor shall be responsible for chemical sample acquisition, sample analysis, instrumental measurements of chemical parameters and for chemical data quality control. An effective chemical data quality control system shall be established that meets the requirements for the chemical measurement DQO applicable to the project. The system shall cover chemical measurements pertaining to and required for Contractor and subcontractor produced chemical data. The Contractor shall control field screening, sampling, and testing in conjunction with remedial activities to meet all DQO; minimize the amount of excavated material requiring temporary storage; prevent dilution of contaminated soils with clean soils; and ensure completion of work within the required time.

### 3.2 QUALITY CONTROL PLAN

#### 3.2.1 General

In addition to the quality control requirements specified in Section 01451 CONTRACTOR QUALITY CONTROL, the CQC Plan shall incorporate the qualifications, authority and responsibilities of all chemical quality management and support personnel. Chemical measurements including sampling and/or chemical parameter measurement will not be permitted to begin until after production and acceptance of the CQC Plan, and Government approval of the SAP.

#### 3.2.2 Chemistry Elements of the CQC Plan

To cover contract related chemical measurements by the Contractor and all subcontractors, the CQC Plan shall include the following as a minimum.

##### 3.2.2.1 Qualifications

Names, education, experience qualifications, authorities, and decision-making responsibilities of all chemical quality management and support personnel. The CQC Plan shall contain a copy of a letter from the project QC manager designating and authorizing a Chemical Quality Control Officer and chemical quality control organization staff.

### 3.2.2.2 Authority and Responsibility

A diagram, flow chart, or figure clearly depicting the chemical data quality management and support staff and the authority and responsibility of each for chemical sampling and analysis, procedures for corrective actions, deliverables and submittals, deviations and changes, chemical quality documentation, data validation, minimum data reporting requirements, and DQO for chemical parameter measurement by the Contractor and subcontractors. The contents of this section of the CQC Plan shall be included in the applicable "Project Organization" elements of the FSP and the QAPP.

### 3.3 SAMPLING AND ANALYSIS PLAN

The SAP shall be prepared in accordance with CDQC requirements and EM 200-1-3. The SAP shall be a single document that contains two distinct elements: FSP and QAPP. Sections of the FSP and QAPP shall be cross referenced. The SAP shall confirm the Contractor's understanding of the contract requirements for chemical data quality control, and shall describe procedures for field sampling and sample submittal for analysis, field chemical parameter measurement, data documentation, data assessment and data reporting requirements. The SAP shall delineate the methods the Contractor intends to use to accomplish the chemical quality control items to assure accurate, precise, representative, complete, legally defensible and comparable data. The SAP shall describe all chemical parameter measurements for all matrices for all phases of the remediation contract. As a single interrelated document, the SAP shall be provided to field and laboratory personnel. The Contractor may propose original/innovative approaches to chemical parameter measurements for cost reduction and remediation efficiency by abbreviated sampling, contingency sampling and/or contingency analysis, indicator or tracer analysis, onsite analytical services, equivalency or screening methods. The SAP shall clearly identify the Contractor obtained laboratories. The Contractor shall furnish copies of the Government approved SAP to all laboratories and the Contractor's field sampling crew. The SAP shall address all levels of the investigation with enough detail to become a document which may be used as an audit guide for field and laboratory work.

#### 3.3.1 Field Sampling Plan

The FSP shall contain necessary technical detail and direction for the field personnel to understand sampling and field measurement requirements. The FSP shall provide a comprehensive description and full detail for personnel to perform all onsite activities required to attain project DQO, including: locations of samples, sampling procedures for onsite and offsite chemical analysis, summaries of analyses to be performed on samples, shipment of samples for offsite analyses, performance of onsite and offsite instrumental parameter measurements, data documentation and reporting requirements.

#### 3.3.2 Quality Assurance Project Plan

The QAPP shall contain necessary technical detail and direction for field and laboratory personnel to understand project sample analysis, quality

control and data reporting requirements, analytical methods, required detection limits, QC requirements, and data validation and reporting requirements.

### 3.4 CHEMISTRY DATA PACKAGE

The chemistry data package shall be produced and provided through USACE CO as an attachment to the CDFR. The chemistry data package shall contain information to demonstrate that the project's DQO have been fulfilled. The QA function will compare QA sample results to corresponding primary sample results, will assess the Contractor's compliance with the SAP, and will recommend corrective action as necessary.

### 3.5 CONTROL OF CHEMICAL DATA QUALITY

Contractor chemical data quality control shall ensure that a quality control program is in place that assures sampling and analytical activities and the resulting chemical parameter measurement data comply with the DQO and the requirements of the SAP. The Contractor shall utilize the three-phase control system that includes a preparatory, initial and follow-up phase for each definable feature of work. The Contractor's three-phase chemical data control process shall ensure that data reporting requirements are achieved and shall be implemented according to Section 01451 CONTRACTOR QUALITY CONTROL. The three-phase chemical data control process shall be combined with that under Section 01451 CONTRACTOR QUALITY CONTROL.

### 3.6 ANALYTICAL TESTING LABORATORIES

The Contractor shall propose the analytical laboratories to be used for the primary samples analyses. Laboratory validation requirements shall be in accordance with paragraph LABORATORY VALIDATION REQUIREMENTS. The Contractor may utilize its own laboratory or utilize subcontract laboratories to achieve the primary required sample analyses.

#### 3.6.1 Laboratory Analytical Requirements

The Contractor shall provide the specified chemical analyses by the Contractor's laboratory. The Contractor shall provide chemical analyses to achieve the project DQO for all parameters specified by the methods. To give the USACE programs the greatest flexibility in the execution of its projects, the EPA SW-846 methods are generally the methods employed for the analytical testing of environmental samples. These methods are flexible and shall be adapted to individual project-specific requirements.

#### 3.6.2 Laboratory Performance

The Contractor shall provide continued acceptable analytical performance and shall establish a procedure to address data deficiencies noted by review and/or quality assurance sample results. The Contractor shall provide and implement a mechanism for providing analytical labs with the SAP or QAPP portion of the SAP, for monitoring the lab's performance and for performing corrective action procedures. The Contractor shall acquire analytical services with additional USACE or State of New York validated

laboratories in the event a project lab loses its validation status during the project.

### 3.7 CHEMICAL DATA FINAL REPORT

The CDFR shall be produced including a summary of quality control practices employed and all chemical parameter measurement activities after project completion. As a minimum, the CDFR shall contain the following:

- a. Summary of project scope and description.
- b. Summary of any deviations from the design chemical parameter measurement specifications.
- c. Summary of chemical parameter measurements performed as contingent measurements.
- d. Summary discussion of resulting data including achieving data reporting requirements.
- e. Summary of achieving project specific DQO.
- f. Presentation and evaluation of the data to include an overall assessment on the quality of the data for each method and matrix.
- g. Internal QC data generated during the project, including tabular summaries correlating sample identifiers with all blank, matrix spikes, surrogates, duplicates, laboratory control samples, and batch identifiers.
- h. A list of the affected sample results for each analyte (indexed by method and matrix) including the appropriate data qualifier flag (J, B, R, etc.), where sample results are negatively impacted by adverse quality control criteria.
- i. Summary of field and laboratory oversight activities, providing a discussion of the reliability of the data, QC problems encountered, and a summary of the evaluation of data quality for each analysis and matrix as indicated by the laboratory QC data and any other relevant findings.
- j. Conclusions and recommendations.
- k. Appendices containing: (1) Chemistry data package, and (2) Results of the Chemical Quality Assurance Report (CQAR). The CQAR is a Government produced document achieved through the inspection and analysis of QA samples and corresponding project sample data. The CQAR will include review of all QC parameters such as holding times, detection limits, method blanks, surrogate recoveries, matrix spikes and duplicates, and inter-laboratory and intra-laboratory data comparisons.

### 3.8 DOCUMENTATION

Documentation records shall be provided as factual evidence that required chemical data has been produced and chemical data quality has been achieved. The documentation shall comply with the requirements specified in paragraphs SAMPLING AND ANALYSIS PLAN, CHEMISTRY DATA PACKAGE, and CHEMICAL DATA FINAL REPORT. Documentation requirements shall be in accordance with Section 01240 COST AND PERFORMANCE REPORT.

### 3.9 NOTIFICATION OF NON-COMPLIANCE

The Contracting Officer will notify the Contractor of any detected noncompliance with the foregoing requirements. The Contractor shall take immediate corrective action after receipt of such notice.

-- End of Section --

## SECTION 02111

EXCAVATION AND HANDLING OF CONTAMINATED MATERIAL  
05/98

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 422	(1963; R 1990) Particle-Size Analysis of Soils
ASTM D 698	(1991) Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/cu. ft. (600 kN-m/cu. m.))
ASTM D 1556	(1990; R 1996) Density and Unit Weight of Soil in Place by the Sand-Cone Method
ASTM D 1557	(1991) Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/cu. ft. (2,700 kN-m/cu. m.))
ASTM D 2167	(1994) Density and Unit Weight of Soil in Place by the Rubber Balloon Method
ASTM D 2487	(1993) Classification of Soils for Engineering Purposes (Unified Soil Classification System)
ASTM D 2922	(1996) Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
ASTM D 4318	(1995a) Liquid Limit, Plastic Limit, and Plasticity Index of Soils
ASTM D 5434	(1993) Guide for Field Logging of Subsurface Explorations of Soil and Rock

## CODE OF FEDERAL REGULATIONS (CFR)

40 CFR 302	Designation, Reportable Quantities, and
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## Notification

## 1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

## SD-02 Shop Drawings

Surveys; G, RE

Cross-sections and areas of excavation.

## SD-03 Product Data

Excavation and Handling Work Plan; G, RE

Work Plan within 30 calendar days after notice to proceed. No work at the site, with the exception of site inspections and surveys, shall be performed until the Work Plan is approved. The Contractor shall allow 30 calendar days in the schedule for the Government's review. No adjustment for time or money will be made if resubmittals of the Work Plan are required due to deficiencies in the plan. At a minimum, the Work Plan shall include:

- a. Schedule of activities.
- b. Method of excavation and equipment to be used.
- c. Shoring or side-wall slopes proposed.
- d. Dewatering plan.
- e. Storage methods and locations for liquid and solid contaminated material.
- f. Borrow sources and haul routes.
- g. Decontamination procedures.
- h. Spill contingency plan.

Closure Report; G, RE

Six (6) copies of Closure Report within 14 calendar days of work completion at the site.

## SD-06 Test Reports

Backfill Material; G, RE

Surveys; G, RE

Confirmation Sampling and Analysis; G, RE  
Sampling of Stored Material; G, RE  
Sampling Liquid; G, RE  
Compaction; G, RE  
Chemical Testing; G, RE

Test results.

### 1.3 SURVEYS

Surveys shall be performed immediately prior to and after excavation of contaminated material to determine the volume of contaminated material removed. The Contractor shall provide cross-sections on [25] [\_\_\_\_\_] foot intervals and at obvious break points for all excavated areas. Locations of confirmation samples shall also be surveyed.

### 1.4 REGULATORY REQUIREMENTS

#### 1.4.1 Permits and Licenses

The Contractor shall obtain required federal, state, and local permits for excavation and storage of contaminated material. Permits shall be obtained at no additional cost to the Government.

### 1.5 DESCRIPTION OF WORK

The work shall consist of excavation and temporary storage of approximately yards of contaminated material. Approximate locations of contaminated material are shown on the drawings. Chemical analysis of contaminated material has not been performed. The Contractor shall perform an independent evaluation of the site characterization data. The Contracting Officer shall be notified within 48 hours if contaminated material is discovered which has not been previously identified or if other discrepancies between data provided and actual field conditions are discovered. Some backfill material is available onsite and typically consists of clay. Ground water is is not expected to be encountered during excavation activities.

### 1.6 CHEMICAL TESTING

Required sampling and chemical analysis shall be conducted in accordance with Section 01450 CHEMICAL DATA QUALITY CONTROL.

### 1.7 SCHEDULING

The Contractor shall notify the Contracting Officer 5 calendar days prior to the start of excavation of contaminated material. The Contractor shall be responsible for contacting regulatory agencies in accordance with the applicable reporting requirements.

## PART 2 PRODUCTS

### 2.1 BACKFILL MATERIAL

Backfill material shall be obtained from [the location indicated on the drawings] [offsite]. Backfill shall be classified in accordance with ASTM D 2487 as GW, GP, GM, GC, SW, SP, SM, SC, ML, MH, CL, or CH and shall be free from roots and other organic matter, trash, debris, snow, ice or frozen materials. Backfill material shall be tested for Atterberg limits (ASTM D 4318), grain-size distribution (ASTM D 422), and compaction characteristics (ASTM D 698 or ASTM D 1557) at a frequency of once per yards. A minimum of one set of classification tests shall be performed per borrow source and 1 backfill sample shall be collected and tested for the following list of contaminants:

Backfill shall not be used until borrow source chemical and physical test results have been submitted and approved.

## 2.2 SPILL RESPONSE MATERIALS

The Contractor shall provide spill response materials including, but not limited to the following: containers, adsorbents, shovels, and personal protective equipment. Spill response materials shall be available at all times in which hazardous materials/wastes are being handled or transported.

Spill response materials shall be compatible with the type of materials and contaminants being handled.

## PART 3 EXECUTION

### 3.1 EXISTING STRUCTURES AND UTILITIES

No excavation shall be performed until site utilities have been field located. The Contractor shall take the necessary precautions to ensure no damage occurs to existing structures and utilities. Damage to existing structures and utilities resulting from the Contractor's operations shall be repaired at no additional cost to the Government. Utilities encountered that were not previously shown or otherwise located shall not be disturbed without written approval from the Contracting Officer.

### 3.2 CLEARING AND GRUBBING

Clearing and grubbing shall be performed to the limits shown on the drawings in accordance with Section 02230 Clearing and Grubbing.

### 3.3 CONTAMINATED MATERIAL REMOVAL

#### 3.3.1 Stripping

The upper feet of soil in the area of contamination shall be considered clean and shall be stripped and stockpiled separately from contaminated material. The upper feet of stripped soil shall be defined as topsoil and shall be stockpiled separately from the remainder of the stripped soil. No liner system will be required beneath stripped material.

#### 3.3.2 Excavation

Areas of contamination shall be excavated to within [60] [\_\_\_\_\_] mm of the depth and extent as directed by the Contracting Officer. Excavation shall

be performed in a manner that will limit the potential for contaminated material to be mixed with uncontaminated material. The Contractor shall maintain an excavation of sufficient size to allow workers ample room to complete the work. A log of the materials and any visible signs of contamination encountered during excavation shall be maintained for each area of excavation. Excavation logs shall be prepared in accordance with ASTM D 5434.

### 3.3.3 Shoring

Sheeting, bracing, or shoring shall be installed in the absence of adequate side slopes if there is a need for workers to enter the excavated area.

### 3.3.4 Dewatering

Surface water shall be diverted to prevent entry into the excavation. Dewatering shall be limited to that necessary to assure adequate access, a safe excavation, and to ensure that compaction requirements can be met.

## 3.4 CONFIRMATION SAMPLING AND ANALYSIS

The Contracting Officer shall be present to inspect the removal of contaminated material from each site. After all material suspected of being contaminated has been removed, the excavation shall be examined for evidence of contamination and, if appropriate, field analysis used to determine the presence of volatile and/or semi-volatile real time vapor monitoring instrument or immunoassay field kits. Excavation of additional material shall be as directed by the Contracting Officer. Samples shall be collected at a frequency of one per yards from the bottom and each of the side walls or as directed by the Contracting Officer. A minimum of one sample shall be collected from the bottom and each side wall of the excavation. Based on test results, the Contractor shall propose any additional excavation which may be required to remove material which is contaminated above action levels. Additional excavation shall be subject to approval by the Contracting Officer. Locations of samples shall be marked in the field and documented on the as-built drawings.

## 3.5 CONTAMINATED MATERIAL STORAGE

Material shall be placed in temporary storage immediately after excavation.

The following paragraphs describe acceptable methods of material storage. Storage units shall be in good condition and constructed of materials that are compatible with the material or liquid to be stored. If multiple storage units are required, each unit shall be clearly labeled with an identification number and a written log shall be kept to track the source of contaminated material in each temporary storage unit.

### 3.5.1 Stockpiles

Stockpiles shall be constructed to isolate stored contaminated material from the environment. The maximum stockpile size shall be yards. Stockpiles shall be constructed to include:

- a. A chemically resistant geomembrane liner. Non-reinforced

geomembrane liners shall have a minimum thickness of [20] [\_\_\_\_\_] mils. Scrim reinforced geomembrane liners shall have a minimum weight of 40 lbs. per 1000 square feet. The ground surface on which the geomembrane is to be placed shall be free of rocks greater than 0.5 inches in diameter and any other object which could damage the membrane.

b. Geomembrane cover to prevent precipitation from entering the stockpile. Non-reinforced geomembrane covers shall have a minimum thickness of 10 mils. Scrim reinforced geomembrane covers shall have a minimum weight of 26 lbs. per 1000 square feet. The cover material shall be anchored to prevent it from being removed by wind.

c. Berms surrounding the stockpile, a minimum of 12 inches in height. Vehicle access points shall also be bermed.

d. Storage and removal of liquid which collects in the stockpile, in accordance with paragraph Liquid Storage.

### 3.5.2 Roll-Off Units

Water-tight roll-off units shall be used to temporarily store contaminated material. An impermeable cover shall be placed over the units to prevent precipitation from contacting the stored material. The units shall be located as directed by the Contracting Officer. Liquid which collects inside the units shall be removed and stored in accordance with paragraph Liquid Storage.

### 3.5.3 Liquid Storage

Liquid collected from excavations and stockpiles shall be temporarily stored in [55 gallon barrels] [[500] [\_\_\_\_\_] gallon tanks]. Liquid storage containers shall be water-tight and shall be located as directed by the Contracting Officer.

## 3.6 SAMPLING

### 3.6.1 Sampling Beneath Storage Units

Samples from beneath and [3] [\_\_\_\_\_] feet outside of each storage unit shall be collected after removal of the storage unit. Samples shall be collected at a frequency of one per each \_\_\_\_\_ yards from a depth interval of [0 to 0.5] [\_\_\_\_\_] feet. Contaminated soil shall be removed at no additional cost to the Government.

## 3.7 SPILLS

In the event of a spill or release of a hazardous substance (as designated in 40 CFR 302), pollutant, contaminant, or oil (as governed by the Oil Pollution Act (OPA), 33 U.S.C. 2701 et seq.), the Contractor shall notify the Contracting Officer immediately. If the spill exceeds the reporting threshold, the Contractor shall follow the pre-established procedures as described in the RCRA Contingency Plan or Base Wide Contingency Plan for

immediate reporting and containment. Immediate containment actions shall be taken to minimize the effect of any spill or leak. Cleanup shall be in accordance with applicable federal, state, and local regulations. As directed by the Contracting Officer, additional sampling and testing shall be performed to verify spills have been cleaned up. Spill cleanup and testing shall be done at no additional cost to the Government.

### 3.8 BACKFILL

#### 3.8.1 Confirmation Test Results

Excavations shall be backfilled immediately after all contaminated materials have been removed and confirmation test results have been approved. After completion of backfilling, a 6 inch layer of top soil shall be placed in a single lift to the lines and grades shown on the drawings.

#### 3.8.2 Compaction

Approved backfill shall be placed in lifts with a maximum loose thickness of [8] [\_\_\_\_\_] inches. Soil shall be compacted to 90 percent of ASTM D 698 or ASTM D 1557 maximum dry density for cohesive soils and 95 percent of ASTM D 698 or ASTM D 1557 maximum dry density for cohesionless soils. Density tests shall be performed at a frequency of once per [10,000] [\_\_\_\_\_] square feet per lift. A minimum of one density test shall be performed on each lift of backfill placed. Field in-place dry density shall be determined in accordance with ASTM D 1556, ASTM D 2167, or ASTM D 2922. If ASTM D 2922 is used, a minimum of one in ten tests shall be checked using ASTM D 1556 or ASTM D 2167. Test results from ASTM D 1556 or ASTM D 2167 shall govern if there is a discrepancy with the ASTM D 2922 test results.

### 3.9 DISPOSAL REQUIREMENTS

Offsite disposal of contaminated material shall be in accordance with Section 02120 TRANSPORTATION AND DISPOSAL OF HAZARDOUS MATERIALS.

### 3.10 CLOSURE REPORT

Six (6) copies of a Closure Report shall be prepared and submitted within 21 calendar days of completing work at the site. The report shall be labeled with the contract number, project name, location, date, name of general contractor, and the Corps of Engineers District contracting for the work. The Closure Report shall include the following information as a minimum:

- a. A cover letter signed by a Professional Engineer registered in the State of New York who is a responsible company official] certifying that all services involved have been performed in accordance with the terms and conditions of the contract documents.
- b. A narrative report including, but not limited to, the following:

(1) site conditions, ground water elevation, and cleanup criteria;

(2) excavation logs;

(3) field screening readings;

(4) quantity of materials removed from each area of contamination;

(5) quantities of water/product removed during dewatering;

(6) sampling locations and sampling methods;

(7) collection data such as time of collection and method of preservation;

(8) sample chain-of-custody forms; and

(9) source of backfill.

c. Copies of all chemical and physical test results.

d. Copies of all manifests and land disposal restriction notifications.

e. Copies of all certifications of final disposal signed by the responsible disposal facility official.

f. Waste profile sheets.

g. Scaled drawings showing limits of each excavation, limits of contamination, known underground utilities within 50 feet of excavation, sample locations, and sample identification numbers.

h. Progress Photographs. Color photographs shall be used to document progress of the work. A minimum of four views of the site showing the location of the area of contamination, entrance/exit road, and any other notable site conditions shall be taken before work begins. After work has been started, activities at each work location shall be photographically recorded daily. Photographs shall be a minimum of 3 x 5 inches and shall include:

(1) Soil removal, handling, and sampling.

(2) Unanticipated events such as discovery of additional contaminated material.

(3) Contaminated material storage.

(4) Site or task-specific employee respiratory and personal protection.

(5) Fill placement and grading.

(6) Post-construction photographs. After completion of work at each site, the Contractor shall take a minimum of four views of each excavation site.

Photographs shall be mounted back-to-back in double face plastic sleeves punched to fit standard three ring binders. Each print shall have an information box attached. The box shall be typewritten and arranged as follows:

Project Name:	Direction of View:
Location:	Date/Time:
Photograph No.:	Description of View:

-- End of Section --

## SECTION 02115

UNDERGROUND STORAGE TANK REMOVAL  
**12/97**

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this section to the extent referenced. The publications are referenced in the text by basic designation only.

## AMERICAN PETROLEUM INSTITUTE (API)

API Pub 2217A	(1997) Guidelines for Work in Inert Confined Spaces in the Petroleum Industry
API Pub 2219	(1999) Safe Operation of Vacuum Trucks in Petroleum Service, 2nd Edition
API RP 1604	(1996) Closure of Underground Petroleum Storage Tanks
API RP 2003	(1998) Protection Against Ignitions Arising out of Static, Lightning, and Stray Currents
API Std 2015	(1994) Safe Entry and Cleaning of Petroleum Storage Tanks

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 1556	(1990; R 1996e1) Density and Unit Weight of Soil in Place by the Sand-Cone Method
ASTM D 1557	(1998) Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/cu. ft. (2,700 kN-m/cu. m.))
ASTM D 2167	(1994) Density and Unit Weight of Soil in Place by the Rubber Balloon Method
ASTM D 2487	(1998) Classification of Soils for Engineering Purposes (Unified Soil Classification System)
ASTM D 2922	(1996e1) Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)

ASTM D 3017 (1988; R 1996el) Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth)

CODE OF FEDERAL REGULATIONS (CFR)

40 CFR 261	Identification and Listing of Hazardous Waste
40 CFR 262	Standards Applicable to Generators of Hazardous Waste
40 CFR 264	Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities
40 CFR 265	Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities
40 CFR 266	Standards for the Management of Specific Hazardous Wastes and Specific Types of Hazardous Waste Management Facilities
40 CFR 268	Land Disposal Restrictions
40 CFR 279	Standards for the Management of Used Oil
40 CFR 280	Technical Standards and Corrective Action Requirements for Owners and Operators of Underground Storage Tanks (UST)

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-03 Product Data

Work Plan; G, RE.

The Work Plan within 30 days after notice to proceed. The Contractor shall allow 30 days in the schedule for the Government's review and approval. No adjustment for time or money will be made for resubmittals required as a result of noncompliance.

Qualifications; G, RE.

A document indicating that the Contractor meets the specified

requirements.

Salvage Rights; FIO.

A record of the disposition of salvaged materials at the end of the contract.

#### SD-06 Test Reports

Backfill Material; G, RE.

Tank Contents Verification; G, RE.

Contaminated Water Disposal; G, RE.

Soil Examination, Testing, and Analysis; G, RE.

Reports including the chain-of-custody records.

Backfilling; G, RE.

Copies of all laboratory and field test reports.

Tank Closure Report; FIO.

Seven copies of the report for each UST site opened, prepared in a standard 3-ring binder, within 14 days of completing work at each site. Each binder shall be labeled with contract number, project name, location and tank number; each binder shall be indexed. A copy of the report shall be furnished to the Installation Environmental Coordinator.

### 1.3 QUALIFICATIONS

The Contractor shall have a minimum of 2 years of tank removal experience and shall be certified by the State of New York for tank removal work.

#### 1.3.1 Laboratory Services

For laboratory services the Contractor shall be validated in accordance with state certification requirements and Section 01450 CHEMICAL DATA QUALITY CONTROL.

#### 1.3.2 Support Staff

The Contractor shall identify all staff involved for the various components, including personnel collecting and shipping samples. The qualifications of these staff members shall be detailed by the Contractor.

### 1.4 REGULATORY REQUIREMENTS

#### 1.4.1 Permits and Licenses

The Contractor, as required or as directed by the Contracting Officer, shall obtain local, state, or federal permits and licenses that directly impact the Contractor's ability to perform the work prior to commencing removal operations.

#### 1.4.2 Statutes and Regulations

Tank closures shall be carried out in accordance with 40 CFR 280, 40 CFR 262, 40 CFR 264, and 40 CFR 265 as well as the applicable local and State of New York regulations. Hazardous material and waste shall be transported in accordance with Section 02120 TRANSPORTATION AND DISPOSAL OF HAZARDOUS MATERIALS.

#### 1.5 PROJECT/SITE CONDITIONS

The work shall consist of removal, decontamination and disposal of four (4) [\_\_\_\_\_] gallon and 1 (one) underground storage tanks and associated piping and ancillary equipment. The tanks are constructed of steel and are at the location shown on the BSC DWgs H - 003, H - 004, and H - 005. The tanks were used for storing fuel oil. Residue remaining in the tank is considered a hazardous waste. Existing native soils are predominantly clay. Available backfill material is typically clay. Groundwater is not expected to be encountered. The Contractor shall verify the actual conditions prior to submitting a bid. The site is not a hazardous waste site but shall be given special consideration due to the nature of the materials and hazards present until closure activities are complete.

##### 1.5.1 Sequencing and Scheduling

The Contractor shall notify the Installation Environmental Coordinator and the Contracting Officer 30 days prior to tank removal. The Contractor shall be responsible for contacting the Implementation Agency (IA) in accordance with the applicable reporting requirements.

##### 1.5.2 Work Plan

The Contractor shall develop, implement, maintain, and supervise as part of the work, a comprehensive plan for tank removal and related operations. As a minimum the plan shall include, but not be limited to, excavation, removal, and ultimate disposal of the tank, its contents, and any contaminated materials. The Work Plan shall be based on work experience, on the requirements of this specification, and on the following references:

- a. API RP 1604.
- b. API Std 2015.
- c. API RP 2003.
- d. API Pub 2217A.
- e. API Pub 2219.

No work at the site, with the exception of site inspections and mobilization, shall be performed until the Work Plan is approved. At a minimum, the Work Plan shall include:

- a. Discussion of the removal approach, tank cleaning, and tank

cutting procedures.

- b. A Sampling and Analysis Plan prepared in accordance with Section: 01450 CHEMICAL DATA QUALITY CONTROL.
- c. Methods to be employed for product, sludge, vapor, and pumpable liquid removal; purging and inerting; and storage methods proposed for control of surface water.
- d. Treatment options.
- e. Identification of waste, tank and contaminated soil transporters and means of transportation.
- f. Treatment, disposal, and alternate facilities, and means of treatment, disposal or remediation.
- g. Borrow source.
- h. Spill prevention plan.
- i. Spill contingency plan.
- j. Decontamination procedures, shoring plan, and safety measures in accordance with Section 01351 SAFETY, HEALTH, AND EMERGENCY RESPONSE (HTRW/UST).

## PART 2 PRODUCTS

### 2.1 BACKFILL MATERIAL

Backfill material shall be obtained and backfilling shall be done in accordance with Section 02315 EXCAVATION, FILLING, AND BACKFILLING FOR BUILDINGS and Section 02316 EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES SYSTEMS.

## PART 3 EXECUTION

### 3.1 GENERAL REQUIREMENTS

#### 3.1.1 Safety Guidelines

Personnel shall abide by the safety guidelines specified in Section 01351 SAFETY, HEALTH, AND EMERGENCY RESPONSE (HTRW/UST).

#### 3.1.2 Burning and Explosives

Use of explosives or burning debris will not be allowed.

#### 3.1.3 Protection of Existing Structures and Utilities

The Contractor shall take all necessary precautions to avoid damage to existing structures, their appurtenances, monitoring wells, or utilities that may be affected by work activities. Any damage to utilities

resulting from the Contractor's operations shall be repaired at no expense to the Government. The Contractor shall coordinate with the installation to locate underground utilities prior to beginning construction. Utilities encountered which were not previously shown or otherwise located shall not be disturbed without approval from the Contracting Officer.

#### 3.1.4 Shoring

Shoring requirements shall be provided in accordance with Section 01351 SAFETY, HEALTH, AND EMERGENCY RESPONSE (HTRW/UST).

### 3.2 TANK CONTENTS VERIFICATION

Sampling and analysis shall be conducted in accordance with the approved Sampling and Analysis Plan and Section 01450 CHEMICAL DATA QUALITY CONTROL.

#### 3.2.1 Sampling

Tank product, pumpable liquids (if found to be present), and sludge shall be sampled by the Contractor. If the data is not adequate, additional sampling and analysis to the extent required by the approved off-site, permitted treatment, storage or disposal (TSD) facility receiving the material shall be the responsibility of the Contractor. Meeting all regulatory requirements, including the preparation of hazardous materials and waste for transportation shall be the responsibility of the Contractor.

#### 3.2.2 Analysis

Tank contents shall be tested by the Contractor for the parameters listed in Section 01450 CHEMICAL DATA QUALITY CONTROL. Analyses shall include [total petroleum hydrocarbons (TPH), benzene, ethylbenzene, toluene and xylene (BETX), and lead.

#### 3.2.3 Characterization

Prior to removing any of the tank contents, the contents shall be characterized to determine if the tank contents must be disposed in a special manner based on local, state, and Federal disposal regulations. Tank product, pumpable liquids (if found to be present), and sludge shall be characterized in accordance with 40 CFR 261 and 40 CFR 279. The waste contents determination and accompanying test results for each phase present in the tank shall be submitted to the Contracting Officer.

### 3.3 CLEARING, GRUBBING AND REMOVALS

Clearing and grubbing shall be in accordance with Section 02230 CLEARING AND GRUBBING.

### 3.4 TOPSOIL

Topsoil shall meet the requirements in Section 02300 EARTHWORK. Uncontaminated topsoil shall be stripped and stockpiled separately for reuse [at a location approved by the Contracting Officer if it meets the requirements of clean fill given in Paragraph BACKFILLING. Additional

topsoil in excess of that produced by excavation shall be obtained off-site or as directed by the Contracting Officer. All areas disturbed by tank removal operations, other than areas to receive pavement or similar surface under this contract, shall be topsoiled.

### 3.5 PREPARATIONS FOR EXCAVATION

Before excavating, the Contractor shall remove residual liquids trapped in the product lines, remove all product from the tank, and the tank shall be purged and vented in accordance with API RP 1604, and as specified herein.

#### 3.5.1 Removal of Product, Pumpable Liquids, and Sludge

Tank product, pumpable liquids, and sludge shall be contained, and stored onsite, prior to disposal. Contaminated water shall be treated as specified. Tank product, pumpable liquids, and sludge shall be removed and disposed of by the Contractor. No Government facilities shall be used for permanent storage or disposal of the wastes. Temporary storage on Government facilities will be allowed only until testing is complete, manifests (if necessary) are complete, and transportation is arranged. The Contractor shall be responsible for obtaining all required permits. The Contractor shall provide approved containers, vehicles, equipment, labor, signs, labels, placards and manifests and associated land disposal restriction notices and notifications, necessary for accomplishment of the work, including materials necessary for cleaning up spills that could occur from tank removal operations.

#### 3.5.2 Contaminated Water Disposal

##### 3.5.2.1 Sampling, Analysis, and Containmentment

Contaminated water produced from excavation operations and tank pumping treated onsite, shall be analyzed for pH; benzene, ethylbenzene, toluene, and xylene (BETX); total lead; oil and grease; and total petroleum hydrocarbons (TPH). Sampling and analysis shall be performed prior to disposal for every [\_\_\_\_\_] [50,000] gallons of contaminated water treated. Analysis for contaminated water to be taken to an off-site treatment facility shall conform to the requirements of the treatment facility with documentation of all analyses performed furnished to the Contracting Officer in accordance with paragraph RECORDS. Contaminated water shall be contained, stored onsite, and analyzed prior to being transported to the approved treatment, storage and disposal facility. The Contractor shall provide approved containers, vehicles, equipment, labor, signs, labels, placards and manifests and associated land disposal notices and notifications, necessary for accomplishment of the work. Sampling and analyses of contaminated water and treated water and the Contractor and laboratory quality assurance program shall be in accordance with Section 01450 CHEMICAL QUALITY CONTROL.

### 3.6 PURGING AND INERTING

After the tank and piping contents have been removed, but prior to excavation beyond the top of the tank, the Contractor shall disconnect all the piping (except the piping needed to purge or inert the tank).

Flammable and toxic vapors shall be purged from the tank or the tank made inert in accordance with API RP 1604, with the exceptions that filling with water shall not be used and, if dry ice is employed, the Contractor shall use a minimum of 3 pounds per 100 gallons of tank volume. The tank atmosphere shall be continuously monitored for combustible vapors if the tank is purged, or continuously monitored for oxygen if the tank is inerted.

### 3.7 EXCAVATION

Excavation areas, as well as work near roadways, shall be marked in accordance with Section 01351 SAFETY, HEALTH, AND EMERGENCY RESPONSE (HTRW/UST).

#### 3.7.1 Exploratory Trenches

Exploratory trenches shall be excavated as necessary to determine the tank location, limits and the location of ancillary equipment.

#### 3.7.2 Tank Excavation

Excavation around the perimeter of the tank shall be performed limiting the amount of potentially petroleum contaminated soil that could be mixed with previously uncontaminated soil. Petroleum contaminated soil shall be segregated in separate stockpiles. The Contractor shall maintain around the tank an excavation of sufficient size to allow workers ample room to complete the work, but also protect the workers from sliding or cave-ins. Sheet piling, bracing, or shoring shall be installed in the absence of adequate side slopes if there is a need for workers to enter the excavated area. Surface water shall be diverted to prevent direct entry into the excavation. Dewatering of the excavation may require a discharge permit by the State and shall be limited to allow adequate access to the tank and piping, to assure a safe excavation, and to ensure that compaction and moisture requirements are met during backfilling. Dewatering may result in the production of petroleum contaminated water and/or free product. Free product shall be recovered from the groundwater only as part of necessary dewatering.

#### 3.7.3 Piping Excavation

Excavation shall be performed as necessary to remove tank piping and ancillary equipment in accordance with paragraphs: Shoring, Tank Excavation, and Open Excavations.

#### 3.7.4 Open Excavations

Open excavations and stockpile areas shall be secured while awaiting confirmation test results from the soil beneath the tank. The excavation shall be backfilled as soon as possible after tank and contaminated soil removals have been completed and confirmation samples have been taken. The Contractor shall divert surface water around excavations to prevent water from directly entering into the excavation.

#### 3.7.5 Stockpiles

Uncontaminated excavated soil and petroleum contaminated soil that is not a state-regulated hazardous waste shall be stockpiled and used for backfill in the tank excavation prior to using borrow material. Excavated material that is regulated by the state as a hazardous waste, which is visibly stained, which has an obvious petroleum odor, or as required by the State of New York or implementing agency shall be considered contaminated and shall be placed in containers such as drums, roll-offs or dumpsters for sampling in accordance with paragraph Stockpiled Material Sampling. Uncontaminated soil shall be stockpiled separately from the contaminated soil, a safe distance away from, but adjacent to, the excavation. The container cover shall prevent rain or surface water from coming into contact with the contaminated soil, as well as limit the escape of the volatile constituents in the container.

### 3.8 REMOVAL OF PIPING, ANCILLARY EQUIPMENT, AND TANK

#### 3.8.1 Piping and Ancillary Equipment

All piping and ancillary equipment shall be disconnected from the tank. The piping shall be removed to the exterior surface of the tank, where it shall be capped and abandoned in place. All tank ancillary equipment and piping connections shall be capped, except those connections necessary to inert the tank within the excavation zone. The piping exterior and ancillary equipment shall be cleaned to remove all soil and inspected for signs of corrosion and leakage. The Contractor shall ensure no spillage of the piping contents occurs, as specified in the Work Plan, and as required in paragraph SPILLS. If the soil under and around the tank pad is contaminated, the tank pad shall be removed and disposed of off-site at an approved [non-hazardous] [hazardous] waste facility. If the soil under and around the tank pad is not contaminated, the tank pad shall remain in place.

#### 3.8.2 Tank

The tank shall be removed from the excavation and the exterior cleaned to remove all soil and inspected for signs of corrosion, structural damage, or leakage. All materials coming into contact with the tank, or in the vicinity of the excavation such as shovels, slings and tools shall be of the non-sparking type. After removal from the excavation, the tank shall be placed on a level surface adjacent to the tank excavation and secured with wood blocks to prevent movement.

#### 3.8.3 Contaminated Soil, Tank and Piping Excavation Examination

After the tank has been removed from the ground, the adjacent and underlying soil shall be examined for any evidence of leakage. The soil shall be visually inspected for staining after removal of all obviously contaminated soil, then screened for the presence of volatile and/or semi-volatile contamination using a real time vapor monitoring instrument or immunoassay field kits. Uncontaminated soil or petroleum contaminated soil not regulated by the state as hazardous waste shall be stockpiled onsite per paragraph Stockpiles. Contaminated soil or suspected contaminated soil shall be containerized, or, if the site is a RCRA-designated CAMU, stockpiled until further disposition. The Contracting Officer or State of New York inspector shall determine the

extent of the contaminated soil to be removed from each site but shall not exceed cubic yards per site. The Contractor shall report any evidence indicating that the amount of contaminated soil may exceed the individual site limit specified, to the Contracting Officer the same day it is discovered. If minimal additional excavation is required, the Contracting Officer may allow the Contractor to proceed. If extensive contamination is encountered, the excavation shall be sampled and backfilled in accordance with paragraph BACKFILLING. After the known contaminated soil is removed, the excavation shall be sampled and analyzed in accordance with Section 01450 CHEMICAL DATA QUALITY CONTROL.

### 3.9 TANK CLEANING

#### 3.9.1 Exterior

Soil shall be removed from the exterior of the tank, piping, and associated equipment to eliminate soil deposition on roadways during transportation to a temporary storage area, ensure markings will adhere to the surfaces, and simplify tank cutting. Soil shall be removed using non-sparking tools. Removed uncontaminated soil and soil not regulated by the state of New York as a hazardous waste shall be recovered and used as backfill in the former tank excavation. Soil believed to be contaminated shall be removed and containerized.

#### 3.9.2 Temporary Storage

If the tank is stored after the tank exterior is cleaned and ancillary equipment is removed, and prior to being cut into sections, the tank shall be labeled as directed in API RP 1604, placed on blocks, and temporarily stored on a flat area adjacent to the excavation. Prior to cleaning the tank interior the tank atmosphere shall be monitored for combustible vapors and purged or inerted if combustible vapors are detected.

#### 3.9.3 Interior

The tank interior shall be [cleaned using a high pressure (greater than 500 psi), low volume (less than 2 gpm) water spray] [or] [steam cleaned] until all loose scale and sludge is removed, and contamination, in the form of a sheen, is no longer visible in the effluent stream. The interior surfaces of piping shall also be cleaned, to the extent possible, using the same method used for cleaning the tank. Contaminated water generated from interior cleaning operations (of both piping and tank) shall not exceed the following quantities for each UST cleaned:

(UST VOLUME (GALLONS))	PERCENT OF UST VOLUME
1,000 or less	5
10,000 or less	5 or 100 gal., whichever is less
20,000 or less	1 or 150 gal., whichever is less
greater than 20,000	1 or 250 gal., whichever is less)

UST VOLUME (GALLONS)	PERCENT OF UST VOLUME
1,000 or less	5
10,000 or less	5 or 100 gal., whichever is less
20,000 or less	1 or 150 gal., whichever is less
greater than 20,000	1 or 250 gal., whichever is less

All contaminated water resulting from cleaning operations shall be handled in accordance with paragraph Contaminated Water Disposal. Cleaning shall be accomplished eliminating, to the greatest extent possible, the need for personnel to enter the tank. Cleaning shall be done using specially designed tank cleaning equipment which allows the tank to be cleaned prior to cutting into sections without requiring personnel to enter the tank or, if less specialized equipment is used, the tank shall be partially dissected to overcome confined space entry hazards. This work shall be accomplished in accordance with Section 01351 SAFETY, HEALTH, AND EMERGENCY RESPONSE (HTRW/UST).

### 3.10 SOIL EXAMINATION, TESTING, AND ANALYSIS

#### 3.10.1 Tank Excavation Sampling Procedures

After soil known to be contaminated has been removed or after soil excavation is complete, the excavation shall be sampled with procedures, number, location, and methodology in accordance with state regulations and Section 01450 CHEMICAL DATA QUALITY CONTROL. Samples shall be obtained from the pits using a backhoe with a Shelby tube attached to the bucket. Sample preservation and analytical procedures shall conform to Section 01450 CHEMICAL DATA QUALITY CONTROL.

#### 3.10.2 Stockpiled Material Sampling

Stockpiled contaminated soil shall be sampled and preserved in accordance with the approved Sampling and Analysis Plan, and Section 01450 CHEMICAL DATA QUALITY CONTROL. Sampling locations, number and specific procedures shall be as required by the State of New York.

#### 3.10.3 Analysis

Soil samples from the excavation and stockpiled material shall be tested in accordance with the approved Sampling and Analysis Plan, and Section 01450 CHEMICAL DATA QUALITY CONTROL for the following parameters: total petroleum hydrocarbon (TPH) [benzene, ethylbenzene, toluene, xylene (BETX)] [toxicity characteristic leaching procedure (TCLP)]. Copies of all test results shall be provided to the Contracting Officer.

### 3.11 BACKFILLING

The tank area and any other excavations shall be backfilled as soon as possible after tank and contaminated soil removals have been completed and confirmation samples have been taken. Contaminated soil removal shall be complete after approval by the Contracting Officer. The excavation shall be dewatered if necessary. Stockpiled material subjected to chemical

confirmation testing shall be used as backfill if it is found to conform to the requirements of clean fill per appropriate state and local regulations.

Backfill consisting of clean fill shall be placed in layers with a maximum loose thickness of [\_\_\_\_\_] [8] inches, and compacted to 90 percent maximum density for cohesive soils and 95 percent maximum density for cohesionless soils. Density tests shall be performed by an approved commercial testing laboratory or by facilities furnished by the Contractor.

Test results shall be attached to contractor's Quality Control Report. A minimum of 1 density test shall be performed on each lift. Laboratory tests for moisture density relations shall be determined in accordance with ASTM D 1557, Method B, C, or D, or ASTM D 3017. A mechanical tamper may be used provided that the results are correlated with those obtained by the hand tamper. Field in-place density shall be determined in accordance with ASTM D 1556, ASTM D 2922, or ASTM D 2167.

### 3.12 DISPOSAL REQUIREMENTS

#### 3.12.1 Treatment, Disposal, and Recycling

Disposal of hazardous wastes shall be in accordance with all local, State, and Federal solid and hazardous waste laws and regulations; the RCRA; Section 02120 TRANSPORTATION AND DISPOSAL OF HAZARDOUS MATERIALS; and conditions specified herein. This work shall include all necessary personnel, labor, transportation, packaging, detailed analyses (if required for disposal, manifesting or completing waste profile sheets), equipment, and reports. Product and pumpable liquids removed from the tank shall be recycled to the greatest extent practicable. The tanks removed shall be disposed of at one of the State of New York approved facilities. Each tank disposed of in this manner shall be manifested as required by the State of New York to document delivery and acceptance at the disposal facility.

#### 3.12.2 Tank and Ancillary Equipment Disposal

After the tanks, piping, and ancillary equipment have been removed from the excavation and the tank cleaned, the tank shall be cut into sections with no dimension greater than [5] [\_\_\_\_\_] feet. Tanks and piping sections shall be disposed of [in a State approved off-site disposal facility. The tanks shall be cut into sections prior to being taken from the tank removal site.

The Contractor shall not sell the tank intact. Ancillary equipment shall be disposed of at an approved off-site disposal facility. Piping shall be disconnected from the tank and removed unless otherwise indicated.

#### 3.12.3 Transportation of Wastes

Transportation shall be provided in accordance with Department of Transportation (DOT) Hazardous Material Regulations and State and local requirements, including obtaining all necessary permits, licenses, and approvals. Evidence that a State licensed hazardous waste transporter is being used shall be included in the SUBMITTALS.

#### 3.12.4 Salvage Rights

The Contractor shall retain the rights to salvage value of recycled or reclaimed product and metal not turned in to the DRMO or otherwise

identified, so long as the requirements of 40 CFR 266 and 40 CFR 279, or the applicable State requirements are met. At the end of the contract, the Contractor shall provide documentation on the disposition of salvaged materials.

#### 3.12.5 Records

Records shall be maintained of all waste determinations, including appropriate results of analyses performed, substances and sample location, the time of collection, and other pertinent data as required by 40 CFR 280, Section 74 and 40 CFR 262 Subpart D, and Section 01450CHEMICAL DATA QUALITY CONTROL. Transportation, treatment, disposal methods and dates, the quantities of waste, the names and addresses of each transporter and the disposal or reclamation facility, shall also be recorded and available for inspection, as well as copies of the following documents:

- a. Manifests.
- b. Waste analyses or waste profile sheets.
- c. Certifications of final treatment/disposal signed by the responsible disposal facility official.
- d. Land disposal notification records required under 40 CFR 268for hazardous wastes.

Records shall be provided in accordance with Section 02120 TRANSPORTATION AND DISPOSAL OF HAZARDOUS MATERIALS. Following contract close out, the records shall become the property of the Government.

#### 3.12.6 Hazardous/Special Waste Manifests

Manifesting shall conform to the requirements specified in Section 02120 TRANSPORTATION AND DISPOSAL OF HAZARDOUS MATERIALS.

#### 3.12.7 Documentation of Treatment or Disposal

The wastes, other than recyclable or reclaimable product or metal, shall be taken to a treatment, storage, or disposal facility which has EPA or appropriate state permits and hazardous or special waste identification numbers and complies with the provisions of the disposal regulations. Documentation of acceptance of special waste or the original return copy of the hazardous waste manifest, signed by the owner or operator of a facility legally permitted to treat or dispose of those materials shall be furnished to the Contracting Officer not later than 5 working days following the delivery of those materials to the facility; and a copy shall be included in the Tank Closure Report. A statement of agreement from the proposed treatment, storage or disposal facility and certified transporters to accept [hazardous] [or special] wastes shall be furnished [in the Work Plan] [to the Contracting Officer not less than 14 days before transporting any wastes]. If the Contractor selects a different facility than is identified in the Work Plan, documentation shall be provided for approval to certify that the facility is authorized and meets the standards specified in 40 CFR 264.

### 3.13 SPILLS

Immediate containment actions shall be taken as necessary to minimize effect of any spill or leak. Cleanup shall be in accordance with applicable Federal, State, local laws and regulations, and district policy at no additional cost to the Government. Refer to Section 02120 TRANSPORTATION AND DISPOSAL OF HAZARDOUS MATERIALS for spill response and reporting requirements.

### 3.14 TANK CLOSURE REPORT

Tank Closure Reports shall include the following information as a minimum:

- a. A cover letter signed by a professional Engineer registered in the State of New York certifying that all services involved have been performed in accordance with the terms and conditions of this specification.
- b. A narrative report describing what was encountered at each site, including:
  - (1) condition of the UST.
  - (2) any visible evidence of leaks or stained soils.
  - (3) results of vapor monitoring readings.
  - (4) actions taken including quantities of materials treated or removed.
  - (5) reasons for selecting sample locations.
  - (6) sample locations.
  - (7) collection data such as time of collection and method of preservation.
  - (8) reasons for backfilling site.
  - (9) whether or not groundwater was encountered.
- c. Copies of all analyses performed for disposal.
- d. Copies of all waste analyses or waste profile sheets.
- e. Copies of all certifications of final disposal signed by the responsible disposal installation official.
- f. Information on who sampled, analyzed, transported, and accepted all wastes encountered, including copies of manifests, waste profile sheets, land disposal restriction, notification and certification forms, certificates of disposal, and other pertinent documentation.

- g. Copies of all analyses performed for confirmation that underlying soil is not contaminated, with copies of chain-of-custody for each sample. Analyses shall give the identification number of the sample used. Sample identification numbers shall correspond to those provided on the one-line drawings.

-- End of Section --

SECTION 02120  
TRANSPORTATION AND DISPOSAL OF HAZARDOUS MATERIALS  
**10/96**

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

## CODE OF FEDERAL REGULATIONS (CFR)

40 CFR 61	National Emission Standards for Hazardous Air Pollutants
40 CFR 261	Identification and Listing of Hazardous Waste
40 CFR 262	Standards Applicable to Generators of Hazardous Waste
40 CFR 263	Standards Applicable to Transporters of Hazardous Waste
40 CFR 264	Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities
40 CFR 265	Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities
40 CFR 266	Standards for the Management of Specific Hazardous Wastes and Specific Types of Hazardous Waste Management Facilities
40 CFR 268	Land Disposal Restrictions
40 CFR 270	EPA Administered Permit Programs: The Hazardous Waste Permit Program
40 CFR 279	Standards for the Management of Used Oil
40 CFR 300	National Oil and Hazardous Substances Pollution Contingency Plan
40 CFR 302	Designation, Reportable Quantities, and Notification

40 CFR 761	Polychlorinated Biphenyls (PCBs) Manufacturing, Processing, Distribution in Commerce, and Use Prohibitions
49 CFR 107	Hazardous Materials Program Procedures
49 CFR 172	Hazardous Materials Table, Special Provisions, Hazardous Materials Communications, Emergency Response Information, and Training Requirements
49 CFR 173	Shippers - General Requirements for Shipments and Packagings
49 CFR 178	Specifications for Packagings

## 1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

### SD-03 Product Data

On-site Hazardous Material Management; G, RE

Prior to start of work, a plan detailing the manner in which hazardous materials shall be managed.

Notices of Non-Compliance and Notices of Violation, G, RE

Notices of non-compliance or notices of violation by a Federal, state, or local regulatory agency issued to the Contractor in relation to any work performed under this contract. The Contractor shall immediately provide copies of such notices to the Contracting Officer. The Contractor shall also furnish all relevant documents regarding the incident and any information requested by the Contracting Officer, and shall coordinate its response to the notice with the Contracting Officer or his designated representative prior to submission to the notifying authority. The Contractor shall also furnish a copy to the Contracting Officer of all documents submitted to the regulatory authority, including the final reply to the notice, and all other materials, until the matter is resolved.

### SD-06 Test Reports

Recordkeeping; G, RE

Information necessary to file state annual or EPA biennial reports for all hazardous material transported, treated, stored, or disposed of under this contract. The Contractor shall not

forward these data directly to the regulatory agency but to the Contracting Officer at the specified time. The submittal shall contain all the information necessary for filing of the formal reports in the form and format required by the governing Federal or state regulatory agency. A cover letter shall accompany the data to include the contract number, Contractor name, and project location.

Spill Response; G, RE

In the event of a spill or release of a hazardous substance (as designated in 40 CFR 302), or pollutant or contaminant, or oil (as governed by the Oil Pollution Act (OPA), 33 U.S.C. 2701 et seq.), the Contractor shall notify the Contracting Officer immediately. If the spill exceeds a reporting threshold, the Contractor shall follow the pre-established procedures for immediate reporting to the Contracting Officer.

Exception Reports; FIO

In the event that a manifest copy documenting receipt of hazardous material at the treatment, storage, and disposal facility is not received within 35 days of shipment initiation, the Contractor shall prepare and submit an exception report to the Contracting Officer within 37 days of shipment initiation.

SD-07 Certificates

Qualifications; G, RE

Copies of the current certificates of registration issued to the Contractor and/or subcontractors or written statements certifying exemption from these requirements.

EPA Off-Site Policy; FIO

A letter certifying that EPA considers the facilities to be used for all off-site disposal to be acceptable in accordance with the Off-Site policy in 40 CFR 300, Section .440. This certification shall be provided for materials from Resource Conservation and Recovery Act (RCRA), 42 U.S.C. 6901 et seq., sites as well as from Comprehensive Environmental Response Compensation and Liability Act (CERCLA), 42 U.S.C. 9601 et seq., responses. See Attachment A, sample certification, at the end of this section.

Management Plan; G, RE

Certificates documenting the ultimate disposal of hazardous materials within 180 days of initial shipment. Receipt of these certificates will be required for final payment.

Shipping Documents and Packagings Certification; G, RE

All transportation related shipping documents to the Contracting

Officer, including draft bill of ladings for hazardous materials and lists of corresponding proposed labels, packages, marks, and placards to be used for shipment for review a minimum of 14 days prior to anticipated pickup. Packaging assurances shall be furnished prior to transporting hazardous material; used oil invoices/shipment records and bill of ladings shall be furnished when shipments are originated; shipment records at the designated disposal facility shall be furnished not later than 35 days after acceptance of the shipment.

### 1.3 QUALIFICATIONS

#### 1.3.1 Transportation and Disposal Coordinator

The Contractor shall designate, by position and title, one person to act as the Transportation and Disposal Coordinator (TDC) for this contract. The TDC shall serve as the single point of contact for all environmental regulatory matters and shall have overall responsibility for total environmental compliance at the site including, but not limited to, accurate identification and classification of hazardous waste and hazardous materials; determination of proper shipping names; identification of marking, labeling, packaging and placarding requirements; completion of material profiles, hazardous waste manifests, bill of ladings, exception and discrepancy reports; and all other environmental documentation. The TDC shall have, at a minimum, one year of specialized experience in the management and transportation of hazardous material.

#### 1.3.2 Training

The Contractor's hazardous materials employees shall be trained, tested, and certified to safely and effectively carry out their assigned duties in accordance with Section 01351 SAFETY, HEALTH, AND EMERGENCY RESPONSE (HTRW/UST). The Contractor's employees transporting hazardous materials or preparing hazardous materials for transportation shall be trained, tested, and certified in accordance with 49 CFR 172.

#### 1.3.3 Certification

The Contractor and/or subcontractors transporting hazardous materials shall possess a current certificate of registration issued by the Research and Special Programs Administration (RSPA), U.S. Department of Transportation, when required by 49 CFR 107, Subpart G.

### 1.4 LAWS AND REGULATIONS REQUIREMENTS

Work shall meet or exceed the minimum requirements established by Federal, state, and local laws and regulations which are applicable. These requirements are amended frequently and the Contractor shall be responsible for complying with amendments as they become effective. In the event that compliance exceeds the scope of work or conflicts with specific requirements of the contract, the Contractor shall notify the Contracting Officer immediately.

### 1.5 DEFINITIONS

- a. Hazardous Material. A substance or material which has been determined by the Secretary of Transportation to be capable of posing an unreasonable risk to health, safety, and property when transported in commerce, and which has been so designated pursuant to the Hazardous Materials Transportation Act, 49 U.S.C. Appendix Section 1801 et seq. The term includes materials designated as hazardous materials under the provisions of 49 CFR 172, Sections .101 and .102 and materials which meet the defining criteria for hazard classes and divisions in 49 CFR 173. EPA designated hazardous wastes are also hazardous materials.
- b. Hazardous Waste. A waste which meets criteria established in RCRA or specified by the EPA in 40 CFR 261 or which has been designated as hazardous by a RCRA authorized state program.

## PART 2 PRODUCTS

### 2.1 MATERIALS

The Contractor shall provide all of the materials required for the packaging, labeling, marking, placarding and transportation of hazardous wastes and hazardous materials in conformance with Department of Transportation standards. Details in this specification shall not be construed as establishing the limits of the Contractor's responsibility.

#### 2.1.1 Packagings

The Contractor shall provide bulk and non-bulk (as needed) containers for packaging hazardous materials/wastes consistent with the authorizations referenced in the Hazardous Materials Table in 49 CFR 172, Section .101, Column 8. Bulk and non-bulk packaging shall meet the corresponding specifications in 49 CFR 173 referenced in the Hazardous Materials Table, 49 CFR 172, Section .101. Each packaging shall conform to the general packaging requirements of Subpart B of 49 CFR 173, to the requirements of 49 CFR 178 at the specified packing group performance level, to the requirements of special provisions of column 7 of the Hazardous Materials Table in 49 CFR 172, Section .101, and shall be compatible with the material to be packaged as required by 40 CFR 262. The Contractor shall also provide other packaging related materials such as materials used to cushion or fill voids in overpacked containers, etc. Sorbent materials shall not be capable of reacting dangerously with, being decomposed by, or being ignited by the hazardous materials being packaged. Additionally, sorbents used to treat free liquids to be disposed of in landfills shall be non-biodegradable as specified in 40 CFR 264, Section .314.

#### 2.1.2 Markings

The Contractor shall provide markings for each hazardous material/waste package, freight container, and transport vehicle consistent with the requirements of 49 CFR 172, Subpart D and 40 CFR 262, Section .32 (for hazardous material. Markings shall be capable of withstanding, without deterioration or substantial color change, a 180 day exposure to conditions reasonably expected to be encountered during container storage and

transportation.

#### 2.1.3 Labeling

The Contractor shall provide primary and subsidiary labels for hazardous materials/wastes consistent with the requirements in the Hazardous Materials Table in 49 CFR 172, Section .101, Column 6. Labels shall meet design specifications required by 49 CFR 172, Subpart E including size, shape, color, printing, and symbol requirements. Labels shall be durable and weather resistant and capable of withstanding, without deterioration or substantial color change, a 180 day exposure to conditions reasonably expected to be encountered during container storage and transportation.

#### 2.1.4 Placards

For each off-site shipment of hazardous material/waste, the Contractor shall provide primary and subsidiary placards consistent with the requirements of 49 CFR 172, Subpart F. Placards shall be provided for each side and each end of bulk packaging, freight containers, transport vehicles, and rail cars requiring such placarding. Placards may be plastic, metal, or other material capable of withstanding, without deterioration, a 30 day exposure to open weather conditions and shall meet design requirements specified in 49 CFR 172, Subpart F.

#### 2.1.5 Spill Response Materials

The Contractor shall provide spill response materials including, but not limited to, containers, adsorbent, shovels, and personal protective equipment. Spill response materials shall be available at all times in which hazardous materials/wastes are being handled or transported. Spill response materials shall be compatible with the type of material being handled.

### 2.2 EQUIPMENT AND TOOLS

The Contractor shall provide miscellaneous equipment and tools necessary to handle hazardous materials and hazardous wastes in a safe and environmentally sound manner.

## PART 3 EXECUTION

### 3.1 ON-SITE HAZARDOUS MATERIAL MANAGEMENT

These paragraphs apply to Government owned material only. Contractors are prohibited by 10 U.S.C. 2692 from storing contractor owned material on site for any length of time. The Contractor shall be responsible for ensuring compliance with all Federal, state, and local hazardous material laws and regulations and shall verify those requirements when preparing reports, material shipment records, hazardous material manifests, or other documents. The Contractor shall identify hazardous materials using criteria set forth in 40 CFR 261 or all applicable state and local laws, regulations, and ordinances. When accumulating hazardous material on-site, the Contractor shall comply with generator requirements in 40 CFR 262 and any applicable state or local law or regulations. On-site accumulation

times shall be restricted to applicable time frames referenced in 40 CFR 262, Section .34 and any applicable state or local law or regulation. Accumulation start dates shall commence when material is first generated (i.e. containerized or otherwise collected for discard). The Contractor shall only use containers in good condition and compatible with the material to be stored. The Contractor shall be responsible for ensuring containers are closed except when adding or removing material. The Contractor shall be responsible for immediately marking all hazardous material containers with the words "hazardous material" and other information required by 40 CFR 262, Section .32 and any applicable state or local law or regulation as soon as the material is containerized. An additional marking shall be placed on containers of "unknowns" designating the date sampled, and the suspected hazard. The Contractor shall be responsible for inspecting containers for signs of deterioration and shall be responsible for responding to any spills or leaks. The Contractor shall inspect all hazardous material areas weekly and shall provide written documentation of the inspection. Inspection logs shall contain date and time of inspection, name of individual conducting the inspection, problems noted, and corrective actions taken.

#### 3.1.1 Hazardous material Classification

The Contractor, in consultation with the Contracting Officer, shall identify all material codes applicable to each hazardous material stream based on requirements in 40 CFR 261 or any applicable state or local law or regulation. The Contractor shall also identify all applicable treatment standards in 40 CFR 268 and state land disposal restrictions and shall make a determination as to whether or not the material meets or exceeds the standards. Material profiles, analyses, classification and treatment standards information shall be submitted to Contracting Officer for review and approval.

#### 3.1.2 Management Plan

The Contractor shall prepare a plan detailing the manner in which hazardous materials will be managed and describing the types and volumes of hazardous materials anticipated to be managed as well as the management practices to be utilized. The plan shall identify the method to be used to ensure accurate piece counts and/or weights of shipments; shall identify material minimization methods; shall propose facilities to be utilized for treatment, storage, and/or disposal; shall identify areas on-site where hazardous materials are to be handled; shall identify whether transfer facilities are to be utilized; and if so, how the materials will be tracked to ultimate disposal.

#### 3.2 OFF-SITE HAZARDOUS MATERIAL MANAGEMENT

The Contractor shall use RCRA Subtitle C permitted facilities which meet the requirements of 40 CFR 264 or facilities operating under interim status which meet the requirements of 40 CFR 265. Off-site treatment, storage, and/or disposal facilities with significant RCRA violations or compliance problems (such as facilities known to be releasing hazardous constituents into ground water, surface water, soil, or air) shall not be used.

### 3.2.1 Description of TSD Facility and Transporter

The Contractor shall provide the Contracting Officer with EPA ID numbers, names, locations, and telephone numbers of TSD facilities and transporters.

This information shall be contained in the Hazardous Material Management Plan for approval prior to material disposal.

### 3.2.2 Status of the Facility

Facilities receiving hazardous material must be permitted in accordance with 40 CFR 270 or operating under interim status in accordance with 40 CFR 265 requirements, or must be permitted by an authorized state program. Additionally, prior to using a TSD Facility, the Contractor shall contact the EPA Regional Off-site Coordinator specified in 40 CFR 300, Section .440, to determine the facility's status, and document all information necessary to satisfy the requirements of the EPA Off-Site policy and furnish this information to the Contracting Officer.

### 3.2.3 Shipping Documents and Packagings Certification

Prior to shipment of any hazardous material off-site, the Contractor's TDC shall provide written certification to the Contracting Officer that hazardous materials have been properly packaged, labeled, and marked in accordance with Department of Transportation and EPA requirements.

### 3.2.4 Transportation

The Contractor shall use manifests for transporting hazardous materials as required by 40 CFR 263 or any applicable state or local law or regulation. Transportation shall comply with all requirements in the Department of Transportation referenced regulations in the 49 CFR series. The Contractor shall acquire manifests in accordance with the hierarchy established in 40 CFR 262, Section .21. The Contractor shall prepare hazardous material manifests for each shipment of hazardous material shipped off-site. Manifests shall be completed using instructions in 40 CFR 262, Subpart B and any applicable state or local law or regulation. Manifests and material profiles shall be submitted to Contracting Officer for review and approval. The Contractor shall prepare land disposal restriction notifications as required by 40 CFR 268 or any applicable state or local law or regulation for each shipment of hazardous material. Notifications shall be submitted with the manifest to the Contracting Officer for review and approval. When the additional cost of sending a qualified USACE representative to a remote location for a small clean up project is unwarranted, the option of requiring the on-site Contractor to sign the manifests on behalf of the generator is permitted and should be considered.

This option shall only be exercised on a project specific basis, if prior to the solicitation process, written authorization of the customer and approval of the Chief, Construction Division at the executing district has been obtained, and the technical provisions of the contract solicitation provide competing contractors notice of the requirement.

### 3.2.5 Treatment and Disposal of Hazardous Materials

The hazardous material shall be transported to an approved hazardous

material treatment, storage, or disposal facility within 90 days of the accumulation start date on each container]. The Contractor shall ship hazardous materials only to facilities which are properly permitted to accept the hazardous material or operating under interim status. The Contractor shall ensure materials are treated to meet land disposal treatment standards in 40 CFR 268 prior to land disposal. The Contractor shall propose TSD facilities via submission of the Hazardous Material Management Plan, subject to the approval of the Contracting Officer.

### 3.3 HAZARDOUS MATERIALS MANAGEMENT

The Contractor, in consultation with the Contracting Officer, shall evaluate, prior to shipment of any material off-site, whether the material is regulated as a hazardous material in addition to being regulated as a hazardous material; this shall be done for the purpose of determining proper shipping descriptions, marking requirements, etc., as described below.

#### 3.3.1 Identification of Proper Shipping Names

The Contractor shall use 49 CFR 172, Section .101 to identify proper shipping names for each hazardous material (including hazardous wastes) to be shipped off-site. Proper shipping names shall be submitted to the Contracting Officer in the form of draft shipping documents for review and approval.

#### 3.3.2 Packaging, Labeling, and Marking

The Contractor shall package, label, and mark hazardous materials/wastes using the specified materials and in accordance with the referenced authorizations. The Contractor shall mark each container of hazardous material of 104 gallons or less with the following:

"HAZARDOUS MATERIAL - Federal Law Prohibits Improper Disposal.  
If found, contact the nearest police or public safety authority or the U.S.  
Environmental Protection Agency.  
Generator's name \_\_\_\_\_  
Manifest Document Number \_\_\_\_\_".

#### 3.3.3 Shipping Documents

The Contractor shall ensure that each shipment of hazardous material sent off-site is accompanied by properly completed shipping documents.

##### 3.3.3.1 Other Hazardous Material Shipment Documents

The Contractor shall prepare a bill of lading for each shipment of hazardous material which is not accompanied by a hazardous material manifest which fulfills the shipping paper requirements. The bill of lading shall satisfy the requirements of 49 CFR 172, Subpart C, and any applicable state or local law or regulation, and shall be submitted to the Contracting Officer for review and approval. For laboratory samples and treatability study samples, the Contractor shall prepare bills of lading and other documentation as necessary to satisfy conditions of the sample

exclusions in 40 CFR 261, Section .4(d) and (e) and any applicable state or local law or regulation. Bill of lading requiring shipper's certifications shall be signed by the Contractor.

#### 3.4 OBTAINING EPA ID NUMBERS

The Contractor shall complete EPA Form 8700-12, Notification of Hazardous Material Activity, and submit to the Contracting Officer for review and approval. The Contractor shall allow a minimum of 30 days for processing the application and assigning the EPA ID number. Shipment shall be made not earlier than one week after receipt of the EPA ID number.

#### 3.5 MATERIAL MINIMIZATION

The Contractor shall minimize the generation of hazardous material to the maximum extent practicable. The Contractor shall take all necessary precautions to avoid mixing clean and contaminated materials. The Contractor shall identify and evaluate recycling and reclamation options as alternatives to land disposal. Requirements of 40 CFR 266 shall apply to: hazardous materials recycled in a manner constituting disposal; hazardous material burned for energy recovery; and hazardous materials with economically recoverable precious metals.

#### 3.6 RECORDKEEPING

The Contractor shall be responsible for maintaining adequate records to support information provided to the Contracting Officer regarding exception reports, annual reports, and biennial reports.

#### 3.7 SPILL RESPONSE

The Contractor shall respond to any spill of hazardous materials which are in the custody or care of the Contractor, pursuant to this contract. Any direction from the Contracting Officer concerning a spill or release shall not be considered a change under the contract. The Contractor shall comply with all applicable requirements of Federal, state, or local laws or regulations regarding any spill incident.

#### 3.8 EMERGENCY CONTACTS

The Contractor shall be responsible for complying with the emergency contact provisions in 49 CFR 172, Section .604. Whenever the Contractor ships hazardous materials, the Contractor shall provide a 24 hr emergency response contact and phone number of a person knowledgeable about the hazardous materials being shipped and who has comprehensive emergency response and incident mitigation information for that material, or has immediate access to a person who possesses such knowledge and information. The phone must be monitored on a 24 hour basis at all times when the hazardous materials are in transportation, including during storage incidental to transportation. The Contractor shall ensure that information regarding this emergency contact and phone number are placed on all hazardous material shipping documents. The Contractor shall designate an emergency coordinator and post the following information at areas in which hazardous materials are managed:

- a. The name of the emergency coordinator.
- b. Phone number through which the emergency coordinator can be contacted on a 24 hour basis.
- c. The telephone number of the local fire department.
- d. The location of fire extinguishers and spill control materials.

Attachment A  
SAMPLE OFF-SITE POLICY CERTIFICATION MEMO

Project/Contract #: \_\_\_\_\_

Waste Stream: \_\_\_\_\_

Primary TSD Facility, EPA ID # and Location: \_\_\_\_\_

Alter. TSD Facility, EPA ID # and Location: \_\_\_\_\_

EPA Region -----	Primary Contact -----	Secondary Contact -----
I	(617) 565-9446	(617) 573-1754
II	(212) 637-4139	(212) 264-2638
III	(814) 566-3450	(215) 597-8338
IV	(404) 562-8589	(404) 347-7603
V	(312) 886-3587	(312) 886-4445
VI	(214) 665-2282	(214) 655-2281
VII	(913) 551-7883	(913) 551-7667
VIII	(303) 312-6419	(303) 293-1506
IX	(415) 744-2091	(415) 744-2114
X	(206) 553-1061	(206) 553-1061

EPA representative contacted: \_\_\_\_\_

EPA representative phone number: \_\_\_\_\_

Date contacted: \_\_\_\_\_

Comment: \_\_\_\_\_

The above EPA representative was contacted on \_\_\_\_\_. As of that date the above sites were considered acceptable in accordance with the Off-Site Policy in 40 CFR 300.440.

Signature: \_\_\_\_\_ Date: \_\_\_\_\_

Phone number: \_\_\_\_\_

-- End of Section --

## SECTION 02930A

## EXTERIOR PLANTING

**06/98**

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

## AMERICAN NURSERY AND LANDSCAPE ASSOCIATION (ANLA)

ANLA Z60.1 (1996) Nursery Stock

## AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI A300 (1995) Tree Care Operations - Trees, Shrubs and other Woody Plant Maintenance

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 602 (1995a) Agricultural Liming Materials

ASTM D 4972 (1995a) pH of Soils

ASTM D 5034 (1995) Breaking Strength and Elongation of Textile Fabrics (Grab Test)

ASTM D 5035 (1995) Breaking Force and Elongation of Textile Fabrics (Strip Method)

ASTM D 5268 (1992; R 1996) Topsoil Used for Landscaping Purposes

ASTM D 5883 (1996e1) Use of Rotary Kiln Produced Expanded Shale, Clay or Slate (ESCS) as a Mineral Amendment in Topsoil Used for Landscaping and Related Purposes

## 1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Shop Drawings; FIO

Scale drawings defining areas to receive plant materials.

Finished Grade, Topsoil and Underground Utilities; FIO

Finished grade status; location of underground utilities and facilities; and availability of topsoil from the stripping and stock piling operation.

SD-03 Product Data

Geotextile; FIO

Chemical Treatment Material; FIO

Manufacturer's literature including physical characteristics, application and installation instructions for geotextile and chemical treatment material.

Equipment; FIO

A listing of equipment to be used for the planting operation.

Delivery; FIO

Delivery schedule.

Plant Establishment Period; G, RE

Calendar time period for the plant establishment period. When there is more than one establishment period, the boundaries of the planted areas covered for each period shall be described.

Maintenance Record; FIO

Maintenance work performed, quantity of plant losses, and replacements; and diagnosis of unhealthy plant material.

Application of Pesticide; FIO

Pesticide treatment plan with sequence of treatment work with dates and times. The pesticide trade name, EPA registration number, chemical composition, formulation, concentration of original and diluted material, application rate of active ingredients, method of application, area treated, amount applied; and the name and state license number of the state certified applicator shall be included.

SD-04 Samples

Delivered Topsoil; FIO

Samples taken from several locations at the source.

Soil Amendments; FIO

A 10 pound sample.

Mulch; FIO

A 10 pound sample.

Geotextile; FIO

A 6 inch square sample.

#### SD-06 Test Reports

Soil Test; FIO

Percolation Test; FIO

Certified reports of inspections and laboratory tests, prepared by an independent testing agency, including analysis and interpretation of test results. Each report shall be properly identified. Test methods used and compliance with recognized test standards shall be described.

#### SD-07 Certificates

Plant Material; FIO

Topsoil; FIO

pH Adjuster; FIO

Fertilizer; FIO

Organic Material; FIO

Soil Conditioner; FIO

Organic Mulch; FIO

Mycorrhizal Fungi Inoculum; FIO

Pesticide; FIO

Prior to delivery of materials, certificates of compliance attesting that materials meet the specified requirements. Certified copies of the material certificates shall include the following.

a. Plant Material: Classification, botanical name, common name, size, quantity by species, and location where grown.

b. Topsoil: Particle size, pH, organic matter content, textural class, soluble salts, chemical and mechanical analyses.

c. pH Adjuster: Sieve analysis and calcium carbonate equivalent.

d. Fertilizer: Chemical analysis and composition percent.

e. Organic Material: Composition and source.

- f. Soil Conditioner: Composition and source.
- g. Organic Mulch: Composition, source, and treatment against fungi growth.
- h. Mycorrhizal Fungi Inoculum: Plant material treated.
- i. Pesticide. EPA registration number and registered uses.

SD-10 Operation and Maintenance Data

Maintenance Instructions; FIO

Instruction for year-round care of installed plant material.

1.3 SOURCE INSPECTIONS

The nursery or source of plant material and the source of delivered topsoil shall be subject to inspection.

1.4 DELIVERY, INSPECTION, STORAGE, AND HANDLING

1.4.1 Delivery

A delivery schedule shall be provided at least 10 calendar days prior to the first day of delivery.

1.4.1.1 Plant Material Identification

Plant material shall be identified with attached, durable, waterproof labels and weather-resistant ink, stating the correct botanical plant name and size.

1.4.1.2 Protection During Delivery

Plant material shall be protected during delivery to prevent desiccation and damage to the branches, trunk, root system, or earth ball. Branches shall be protected by tying-in. Exposed branches shall be covered during transport.

1.4.1.3 Delivered Topsoil

Prior to the delivery of any topsoil, the availability of topsoil shall be verified in paragraph TOPSOIL. A soil test shall be provided for delivered topsoil.

1.4.1.4 Soil Amendments

Soil amendments shall be delivered to the site in the original, unopened containers bearing the manufacturer's chemical analysis. In lieu of containers, soil amendments may be furnished in bulk. A chemical analysis shall be provided for bulk deliveries.

1.4.1.5 Pesticide Material

Pesticide material shall be delivered to the site in the original, unopened containers bearing legible labels indicating the Environmental Protection Agency (EPA) registration number and the manufacturer's registered uses.

#### 1.4.2 Inspection

Plant material shall be well shaped, vigorous and healthy with a healthy, well branched root system, free from disease, harmful insects and insect eggs, sun-scald injury, disfigurement or abrasion. Plant material shall be checked for unauthorized substitution and to establish nursery grown status. Plant material showing desiccation, abrasion, sun-scald injury, disfigurement, or unauthorized substitution shall be rejected. The plant material shall exhibit typical form of branch to height ratio; and meet the caliper and height measurements specified. Plant material that measures less than specified, or has been poled, topped off or headed back, shall be rejected. Container-grown plant material shall show new fibrous roots and the root mass shall contain its shape when removed from the container. Plant material with broken or cracked balls; or broken containers shall be rejected. Bare-root plant material that is not dormant or is showing roots were pulled from the ground shall be rejected. Other materials shall be inspected for compliance with paragraph PRODUCTS. Open soil amendment containers or wet soil amendments shall be rejected. Topsoil that contains slag, cinders, stones, lumps of soil, sticks, roots, trash or other material larger than 1-1/2 inch diameter shall be rejected. Topsoil that contains viable plant material and plant parts shall be rejected. Unacceptable material shall be removed from the job site.

#### 1.4.3 Storage

##### 1.4.3.1 Plant Material Storage

Plant material not installed on the day of arrival at the site shall be stored and protected in designated areas. Plant material shall not be stored longer than 30 days. Plant material shall be protected from direct exposure to wind and sun. Bare-root plant material shall be heeled-in. All plant material shall be kept in a moist condition by watering with a fine mist spray until installed.

##### 1.4.3.2 Other Material Storage

Storage of other material shall be in designated areas. Soil amendments shall be stored in dry locations and away from contaminants. Chemical treatment material shall be stored according to manufacturer's instructions and not with planting operation material.

#### 1.4.4 Handling

Plant material shall not be injured in handling. Cracking or breaking the earth ball of balled and burlapped plant material shall be avoided. Plant material shall not be handled by the trunk or stems. Materials shall not be dropped from vehicles.

#### 1.4.5 Time Limitation

Except for container-grown plant material, the time limitation from digging to installing plant material shall be a maximum 90 days. The time limitation between installing the plant material and placing the mulch shall be a maximum 24 hours.

#### 1.5 WARRANTY

Furnished plant material shall have a warranty for plant growth to be in a vigorous growing condition for a minimum 12 month period. A minimum 12 month calendar time period for the warranty of plant growth shall be provided regardless of the contract time period. When plant material is determined to be unhealthy in accordance with paragraph PLANT ESTABLISHMENT PERIOD, it shall be replaced once under this warranty.

### PART 2 PRODUCTS

#### 2.1 PLANT MATERIAL

##### 2.1.1 Plant Material Classification

The plant material shall be nursery grown stock conforming to ANLA Z60.1 and shall be the species specified.

##### 2.1.2 Plant Schedule

The plant schedule shall provide botanical names as included in one or more of the publications listed under "Nomenclature" in ANLA Z60.1.

##### 2.1.3 Substitutions

Substitutions will not be permitted without written request and approval from the Contracting Officer.

##### 2.1.4 Quality

Well shaped, well grown, vigorous plant material having healthy and well branched root systems in accordance with ANLA Z60.1 shall be provided. Plant material shall be provided free from disease, harmful insects and insect eggs, sun-scald injury, disfigurement and abrasion. Plant material shall be free of shock or damage to branches, trunk, or root systems, which may occur from the digging and preparation for shipment, method of shipment, or shipment. Plant quality is determined by the growing conditions; method of shipment to maintain health of the root system; and growth of the trunk and crown as follows.

##### 2.1.5 Growing Conditions

Plant material shall be native to or well-suited to the growing conditions of the project site. Plant material shall be grown under climatic conditions similar to those at the project site.

##### 2.1.6 Method of Shipment to Maintain Health of Root System

#### 2.1.6.1 Balled and Burlapped (BB) Plant Material

Ball size and ratio shall be in accordance with ANLA Z60.1. The ball shall be of a diameter and depth to encompass enough fibrous and feeding root system necessary for the full recovery of the plant. The plant stem or trunk shall be centered in the ball. All roots shall be clean cut at the ball surface. Roots shall not be pulled from the ground. Before shipment the root ball shall be dipped in gels containing mycorrhizal fungi inoculum. The root ball shall be completely wrapped with burlap or other suitable material and securely laced with biodegradable twine.

#### 2.1.7 Growth of Trunk and Crown

##### 2.1.7.1 Deciduous Trees

A height to caliper relationship shall be provided in accordance with ANLA Z60.1. Height of branching shall bear a relationship to the size and species of tree specified and with the crown in good balance with the trunk. The trees shall not be "poled" or the leader removed.

- a. Single stem: The trunk shall be reasonably straight and symmetrical with crown and have a persistent main leader.
- b. Multi-stem: All countable stems, in aggregate, shall average the size specified. To be considered a stem, there shall be no division of the trunk which branches more than 6 inches from ground level.
- c. Specimen: The tree provided shall be well branched and pruned naturally according to the species. The form of growth desired, which may not be in accordance with natural growth habit, shall be as indicated.

#### 2.2 TOPSOIL

Topsoil shall be as defined in ASTM D 5268. When available, the topsoil shall be the existing surface soil stripped and stockpiled onsite in accordance with Section 02300 EARTHWORK. When additional topsoil is required beyond the available topsoil from the stripping operation, topsoil shall be delivered and amended as recommended by the soil test for the plant material specified. Topsoil shall be free from slag, cinders, stones, lumps of soil, sticks, roots, trash or other material over a minimum 1-1/2 inch diameter. Topsoil shall be free from viable plants and plant parts.

#### 2.3 SOIL AMENDMENTS

Soil amendments shall consist of pH adjuster, fertilizer, organic material and soil conditioners meeting the following requirements. Vermiculite is not recommended.

##### 2.3.1 pH Adjuster

The pH adjuster shall be an agricultural liming material in accordance with

ASTM C 602. These materials may be burnt lime, hydrated lime, ground limestone, or shells. The pH adjuster shall be used to create a favorable soil pH for the plant material specified.

#### 2.3.1.1 Limestone

Limestone material shall contain a minimum calcium carbonate equivalent of 80 percent. Gradation: A minimum 95 percent shall pass through a No. 8 sieve and a minimum 55 percent shall pass through a No. 60 sieve. To raise soil pH, ground limestone shall be used.

#### 2.3.1.2 Hydrated Lime

Hydrated lime shall contain a minimum calcium carbonate equivalent of 110 percent. Gradation: A minimum 100 percent shall pass through a No. 8 sieve and a minimum 97 percent shall pass through a No. 60 sieve.

#### 2.3.1.3 Burnt Lime

Burnt lime shall contain a minimum calcium carbonate equivalent of 140 percent. Gradation: A minimum 95 percent shall pass through a No. 8 sieve and a minimum 35 percent shall pass through a No. 60 sieve.

#### 2.3.2 Fertilizer

The nutrients ratio shall be 10 percent nitrogen, 6 percent phosphorus, and 4 percent potassium. Fertilizer shall be controlled release commercial grade; free flowing, pellet or tablet form; uniform in composition; and consist of a nitrogen-phosphorus-potassium ratio. The fertilizer shall be derived from sulphur coated urea, urea formaldehyde, plastic or polymer coated pills, or isobutylenediurea (IBDU). Fertilizer shall be balanced with the inclusion of trace minerals and micro-nutrients.

#### 2.3.3 Organic Material

Organic material shall consist of either bonemeal, peat, rotted manure, decomposed wood derivatives, recycled compost, or worm castings.

##### 2.3.3.1 Bonemeal

Bonemeal shall be a finely ground, steamed bone product containing from 2 to 4 percent nitrogen and 16 to 40 percent phosphoric acid.

##### 2.3.3.2 Rotted Manure

Rotted manure shall be unleached horse, chicken, or cattle manure containing a maximum 25 percent by volume of straw, sawdust, or other bedding materials. Manure shall contain no chemicals or ingredients harmful to plants. The manure shall be heat treated to kill weed seeds and shall be free of stones, sticks, and soil.

##### 2.3.3.3 Decomposed Wood Derivatives

Decomposed wood derivatives shall be ground bark, sawdust, or other wood

waste material free of stones, sticks, and toxic substances harmful to plants, and stabilized with nitrogen.

#### 2.3.3.4 Recycled Compost

Compost shall be a well decomposed, stable, weed free organic matter source. It shall be derived from food, agricultural, or industrial residuals; biosolids (treated sewage sludge); yard trimmings; or source-separated or mixed solid waste. The compost shall possess no objectionable odors and shall not resemble the raw material from which it was derived. The material shall not contain substances toxic to plants. Gradation: The compost material shall pass through a 3/8 inch screen, possess a pH of 5.5 to 8.0, and have a moisture content between 35-55 percent by weight. The material shall not contain more than 1 percent or less by weight of man-made foreign matter. Compost shall be cleaned of plastic materials larger than 2 inches in length.

#### 2.3.3.5 Worm Castings

Worm castings shall be screened from worms and food source and shall be commercially packaged.

#### 2.3.4 Soil Conditioner

Soil conditioner shall be sand, super absorbent polymers, calcined clay, or gypsum for single use or in combination to meet topsoil requirements for the plant material specified.

##### 2.3.4.1 Sand

Sand shall be clean and free of toxic materials. Gradation: A minimum 95 percent by weight shall pass a No. 10 sieve and a minimum 10 percent by weight shall pass a No. 16 sieve. Greensand shall be balanced with the inclusion of trace minerals and nutrients.

##### 2.3.4.2 Super Absorbent Polymers

To improve water retention in soils, super absorbent polymers shall be sized according to manufacturer's recommendations. Polymers shall be added as a soil amendment and be cross-linked polyacrylamide with an absorption capacity of 250-400 times its weight.

##### 2.3.4.3 Calcined Clay

Granular particles shall be produced from montmorillonite clay calcined to minimum temperature of 1200 degrees F. Gradation: A minimum 90 percent passing No. 8 sieve; a minimum 99 percent shall be retained on No. 60 sieve; and a maximum 2 percent shall pass a No. 100 sieve. Bulk density: A maximum 40 pounds per cubic foot.

##### 2.3.4.4 Gypsum

Gypsum shall be commercially packaged, free flowing, and a minimum 95 percent calcium sulfate by volume.

#### 2.3.4.5 Expanded Shale, Clay, or Slate (ESCS)

Rotary kiln produced ESCS material shall be in conformance with ASTM D 5883.

#### 2.4 MULCH

Mulch shall be free from weeds, mold, and other deleterious materials. Mulch materials shall be native to the region. Rotted manure is not recommended to be used as a mulch because it would encourage surface rooting of the plant material and weeds.

##### 2.4.1 Organic Mulch

Organic mulch materials shall be native to the project site and consist of recycled mulch, shredded bark, wood chips, or ground bark.

##### 2.4.1.1 Recycled Mulch

Recycled mulch may include compost, tree trimmings, or pine needles with a gradation that passes through a 2-1/2 x 2-1/2 inch screen. It shall be cleaned of all sticks a minimum 1 inch in diameter and plastic materials a minimum 3 inch length. The material shall be treated to retard the growth of mold and fungi. Other recycled mulch may include peanut shells, pecan shells or coco bean shells.

##### 2.4.1.2 Shredded Bark

Locally shredded material shall be treated to retard the growth of mold and fungi.

##### 2.4.1.3 Wood Chips and Ground Bark

Locally chipped or ground material shall be treated to retard the growth of mold and fungi. Gradation: A maximum 2 inch wide by 4 inch long.

#### 2.5 GEOTEXTILE

Geotextile shall be woven or nonwoven; polypropylene, polyester, or fiberglass, mat in accordance with ASTM D 5034 or ASTM D 5035. It shall be made specifically for use as a fabric around plant material. Nominal weight shall be a minimum 4 ounces per square yard. Permeability rate shall be a minimum 0.04 inch per second.

#### 2.6 WOOD STAKING MATERIAL

Wood stakes shall be hardwood or fir; rough sawn; free from knots, rot, cross grain, or other defects that would impair their strength.

##### 2.6.1 Bracing Stake

Wood bracing stakes shall be a minimum 2 x 2 inch square and a minimum 8 feet long with a point at one end. Stake shall be set without damaging rootball.

## 2.6.2 Wood Ground Stakes

Wood ground stakes shall be a minimum of 2 x 2 inch square and a minimum 3 feet long with a point at one end.

## 2.7 METAL STAKING AND GUYING MATERIAL

Metal shall be aluminum or steel consisting of recycled content made for holding plant material in place.

### 2.7.1 Bracing Stakes

Metal bracing stakes shall be a minimum 1 inch diameter and a minimum 8 feet long. Stake shall be set without damaging rootball.

### 2.7.2 Metal Ground Stakes

Metal ground stakes shall be a minimum 1/2 inch diameter and a minimum 3 feet long.

### 2.7.3 Guying Material

Metal guying material shall be a minimum 12 gauge wire. Multi-strand cable shall be woven wire. Guying material tensile strength shall conform to the size of tree to be held firmly in place.

### 2.7.4 Turnbuckle

Metal turnbuckles shall be galvanized or cadmium-plated steel, and shall be a minimum 3 inches long with closed screw eyes on each end. Screw thread tensile strength shall conform to the size of tree to be held firmly in place.

## 2.8 PLASTIC STAKING AND GUYING MATERIAL

Plastic shall consist of recycled plastic product made for holding plant material firmly in place.

### 2.8.1 Plastic Bracing Stake

Plastic bracing stakes shall be a minimum 2 inch diameter and a minimum 8 feet long. Stake shall be set without damaging rootball.

### 2.8.2 Plastic Ground Stakes

Plastic ground stakes shall be a minimum 1 inch diameter and a minimum 3 feet long.

### 2.8.3 Plastic Guying Material

Plastic guying material shall be designed specifically for the purpose of firmly holding plant material in high wind velocities.

#### 2.8.4 Chafing Guard

Plastic chafing guards shall be used to protect tree trunks and branches when metal is used as guying material. The material shall be the same color throughout the project site. Length shall be a minimum 1.5 times the circumference of the plant trunk at its base.

#### 2.9 RUBBER GUYING MATERIAL

Rubber chafing guards, consisting of recycled material, shall be used to protect tree trunks and branches when metal guying material is applied. The material shall be the same color throughout the project. Length shall be a minimum 1.5 times the circumference of the plant trunk at its base.

#### 2.10 FLAG

Plastic flag material shall be used on guying material. It shall be a minimum 6 inches long. Tape color shall be consistent and visually complimentary to the entire project area. The tape color shall meet pedestrian visual safety requirements for day and night.

#### 2.11 MYCORRHIZAL FUNGI INOCULUM

Mycorrhizal fungi inoculum shall be composed of multiple-fungus inoculum as recommended by the manufacturer for the plant material specified.

#### 2.12 WATER

Unless otherwise directed, water shall be the responsibility of the Contractor. Water shall not contain elements toxic to plant life.

#### 2.13 PESTICIDE

Pesticide shall be insecticide, herbicide, fungicide, nematocide, rodenticide or miticide. For the purpose of this specification a soil fumigant shall have the same requirements as a pesticide. The pesticide material shall be EPA registered and approved.

### PART 3 EXECUTION

#### 3.1 INSTALLING PLANT MATERIAL TIME AND CONDITIONS

##### 3.1.1 Deciduous Plant Material Time

Deciduous plant material shall be installed from mid-September to mid-November or from mid-February to the end of April.

##### 3.1.2 Plant Material Conditions

Planting operations shall be performed only during periods when beneficial results can be obtained. When drought, excessive moisture, frozen ground or other unsatisfactory conditions prevail, the work shall be stopped when directed. When special conditions warrant a variance to the planting operations, proposed planting times shall be submitted for approval.

### 3.1.3 Tests

#### 3.1.3.1 Percolation Test

Test for percolation shall be done to determine positive drainage of plant pits and beds. A positive percolation shall consist of a minimum 1 inch per 3 hours; when a negative percolation test occurs, a shop drawing shall be submitted indicating the corrective measures.

#### 3.1.3.2 Soil Test

Delivered topsoil, excavated plant pit soil, and stockpiled topsoil shall be tested in accordance with ASTM D 5268 and ASTM D 4972 for determining the particle size, pH, organic matter content, textural class, chemical analysis, soluble salts analysis, and mechanical analysis. Sample collection onsite shall be random over the entire site. Sample collection for stockpiled topsoil shall be at different levels in the stockpile. The soil shall be free from debris, noxious weeds, toxic substances, or other materials harmful to plant growth. The test shall determine the quantities and type of soil amendments required to meet local growing conditions for the plant material specified.

### 3.2 SITE PREPARATION

#### 3.2.1 Finished Grade, Topsoil and Underground Utilities

The Contractor shall verify that finished grades are as indicated on drawings, and that the placing of topsoil, the smooth grading, and the compaction requirements have been completed in accordance with Section 02300 EARTHWORK, prior to the commencement of the planting operation. The location of underground utilities and facilities in the area of the planting operation shall be verified. Damage to underground utilities and facilities shall be repaired at the Contractor's expense.

#### 3.2.2 Layout

Plant material locations and bed outlines shall be staked on the project site before any excavation is made. Plant material locations may be adjusted to meet field conditions.

#### 3.2.3 Protecting Existing Vegetation

When there are established lawns in the planting area, the turf shall be covered and/or protected during planting operations. Existing trees, shrubs, and plant beds that are to be preserved shall be barricaded along the dripline to protect them during planting operations.

### 3.3 EXCAVATION

#### 3.3.1 Obstructions Below Ground

When obstructions below ground affect the work, shop drawings showing proposed adjustments to plant material location, type of plant and planting

method shall be submitted for approval.

### 3.3.2 Turf Removal

Where the planting operation occurs in an existing lawn area, the turf shall be removed from the excavation area to a depth that will ensure the removal of the entire root system.

### 3.3.3 Plant Pits

Plant pits for ball and burlapped or container plant material shall be dug to a depth equal to the height of the root ball as measured from the base of the ball to the base of the plant trunk. Plant pits shall be dug a minimum 50 percent wider than the ball or root system to allow for root expansion. The pit shall be constructed with vertical walls.

## 3.4 INSTALLATION

### 3.4.1 Setting Plant Material

Plant material shall be set plumb and held in position until sufficient soil has been firmly placed around root system or ball. In relation to the surrounding grade, the plant material shall be set even with the grade at which it was grown.

### 3.4.2 Backfill Soil Mixture

The backfill soil mixture may be a mix of topsoil and soil amendments suitable for the plant material specified. When practical, the excavated soil from the plant pit that is not amended provides the best backfill and shall be used.

### 3.4.3 Adding Mycorrhizal Fungi Inoculum

Mycorrhizal fungi inoculum shall be added as recommended by the manufacturer for the plant material specified.

### 3.4.4 Backfill Procedure

Prior to backfilling, all metal, wood, synthetic products, or treated burlap devices shall be removed from the ball or root system avoiding damage to the root system. The backfill procedure shall remove air pockets from around the root system. Additional requirements are as follows.

#### 3.4.4.1 Balled and Burlapped Plant Material

Biodegradable burlap and tying material shall be carefully opened and folded back from the top a minimum 1/3 depth from the top of the root ball. Backfill mixture shall be added to the plant pit in 6 inch layers with each layer tamped.

#### 3.4.4.2 Earth Berm

An earth berm, consisting of backfill soil mixture, shall be formed with a

minimum 4 inch height around the edge of the plant pit to aid in water retention and to provide soil for settling adjustments.

#### 3.4.5 Watering

Plant pits and plant beds shall be watered immediately after backfilling, until completely saturated.

#### 3.4.6 Staking and Guying

Staking will be required when trees are unstable or will not remain set due to their size, shape, or exposure to high wind velocity.

##### 3.4.6.1 Three Ground Stakes

Trees over a minimum 8 feet height and less than a maximum 6 inch caliper shall be held firmly in place with 3 bracing or ground stakes spaced equidistantly around the tree. Ground stakes shall be avoided in areas to be mowed. Stakes shall be driven into firm ground outside the earth berm. The guying material shall be firmly anchored at a minimum 1/2 tree height and shall prevent girdling. For trees over maximum 3 inch diameter at breast height, turnbuckles shall be used on the guying material for tree straightening purposes. One turnbuckle shall be centered on each guy line. Chafing guards shall be used when metal is the guying material.

#### 3.4.7 Flags

A flag shall be securely fastened to each guy line equidistant between the tree and the stake. The flag shall be visible to pedestrians.

### 3.5 FINISHING

#### 3.5.1 Plant Material

Prior to placing mulch, the installed area shall be uniformly edged to provide a clear division line between the planted area and the adjacent turf area, shaped as indicated. The installed area shall be raked and smoothed while maintaining the earth berms.

#### 3.5.2 Placing Geotextile

Prior to placing mulch, geotextile shall be placed as indicated in accordance with the manufacturer's recommendations.

#### 3.5.3 Placing Mulch

The placement of mulch shall occur a maximum 48 hours after planting. Mulch, used to reduce soil water loss, regulate soil temperature and prevent weed growth, shall be spread to cover the installed area with a minimum 4 inch uniform thickness. Mulch shall be kept off buildings, sidewalks and other facilities.

#### 3.5.4 Pruning

Pruning shall be accomplished by trained and experienced personnel. The pruning of trees and palms shall be in accordance with ANSI A300. Only dead or broken material shall be pruned from installed plants. The typical growth habit of individual plant material shall be retained. Clean cuts shall be made flush with the parent trunk. Improper cuts, stubs, dead and broken branches shall be removed. "Headback" cuts at right angles to the line of growth will not be permitted. Trees shall not be poled or the leader removed, nor shall the leader be pruned or "topped off".

### 3.6 MAINTENANCE DURING PLANTING OPERATION

Installed plant material shall be maintained in a healthy growing condition. Maintenance operations shall begin immediately after each plant is installed to prevent desiccation and shall continue until the plant establishment period commences. Installed areas shall be kept free of weeds, grass, and other undesired vegetation. The maintenance includes maintaining the mulch, watering, and adjusting settling.

### 3.7 APPLICATION OF PESTICIDE

When application of a pesticide becomes necessary to remove a pest or disease, a pesticide treatment plan shall be submitted and coordinated with the installation pest management program.

#### 3.7.1 Technical Representative

The certified installation pest management coordinator shall be the technical representative, and shall be present at all meetings concerning treatment measures for pest or disease control. They may be present during treatment application.

#### 3.7.2 Application

A state certified applicator shall apply required pesticides in accordance with EPA label restrictions and recommendations. Clothing and personal protective equipment shall be used as specified on the pesticide label. A closed system is recommended as it prevents the pesticide from coming into contact with the applicator or other persons. Water for formulating shall only come from designated locations. Filling hoses shall be fitted with a backflow preventer meeting local plumbing codes or standards. Overflow shall be prevented during the filling operation. Prior to each day of use, the equipment used for applying pesticide shall be inspected for leaks, clogging, wear, or damage. Any repairs are to be performed immediately.

### 3.8 RESTORATION AND CLEAN UP

#### 3.8.1 Restoration

Turf areas, pavements and facilities that have been damaged from the planting operation shall be restored to original condition at the Contractor's expense.

#### 3.8.2 Clean Up

Excess and waste material shall be removed from the installed area and shall be disposed offsite. Adjacent paved areas shall be cleared.

### 3.9 PLANT ESTABLISHMENT PERIOD

#### 3.9.1 Commencement

Upon completion of the last day of the planting operation, the plant establishment period for maintaining installed plant material in a healthy growing condition shall commence and shall be in effect for a minimum of 90 days or the remaining contract time period, whichever is longer, not to exceed 12 months. Written calendar time period shall be furnished for the plant establishment period. When there is more than one plant establishment period, the boundaries of the planted area covered for each period shall be described. The plant establishment period shall be coordinated with Sections 02921 SEEDING. The plant establishment period shall be modified for inclement weather shut down periods, or for separate completion dates for areas.

#### 3.9.2 Maintenance During Establishment Period

Maintenance of plant material shall include straightening plant material, straightening stakes; tightening guying material; correcting girdling; supplementing mulch; pruning dead or broken branch tips; maintaining plant material labels; watering; eradicating weeds, insects and disease; post-fertilization; and removing and replacing unhealthy plants.

##### 3.9.2.1 Watering Plant Material

The plant material shall be watered as necessary to prevent desiccation and to maintain an adequate supply of moisture within the root zone. An adequate supply of moisture is estimated to be the equivalent of 1 inch absorbed water per week, delivered in the form of rain or augmented by watering. Run-off, puddling and wilting shall be prevented. Unless otherwise directed, watering trucks shall not be driven over turf areas. Watering of other adjacent areas or existing plant material shall be prevented.

##### 3.9.2.2 Weeding

Grass and weeds in the installed areas shall not be allowed to reach a maximum 3 inches height before being completely removed, including the root system.

##### 3.9.2.3 Pesticide Treatment

Treatment for disease or pest shall be in accordance with paragraph APPLICATION OF PESTICIDE.

##### 3.9.2.4 Post-Fertilization

The plant material shall be topdressed at least once during the period of establishment with controlled release fertilizer, reference paragraph SOIL AMENDMENTS. Apply at the rate of 2 pounds per 100 square feet of plant

pit or bed area. Dry fertilizer adhering to plants shall be flushed off. The application shall be timed prior to the advent of winter dormancy.

#### 3.9.2.5 Plant Pit Settling

When settling occurs to the backfill soil mixture, additional backfill soil shall be added to the plant pit or plant bed until the backfill level is equal to the surrounding grade. Serious settling that affects the setting of the plant in relation to the maximum depth at which it was grown requires replanting in accordance with paragraph INSTALLATION. The earth berm shall be maintained.

#### 3.9.2.6 Maintenance Record

A record shall be furnished describing the maintenance work performed, the quantity of plant losses, diagnosis of the plant loss, and the quantity of replacements made on each site visit.

#### 3.9.3 Unhealthy Plant Material

A tree shall be considered unhealthy or dead when the main leader has died back, or up to a maximum 25 percent of the crown has died. This condition shall be determined by scraping on a branch an area 1/16 inch square, maximum, to determine if there is a green cambium layer below the bark. The Contractor shall determine the cause for unhealthy plant material and shall provide recommendations for replacement. Unhealthy or dead plant material shall be removed immediately and shall be replaced as soon as seasonal conditions permit.

#### 3.9.4 Replacement Plant Material

Unless otherwise directed, plant material shall be provided for replacement in accordance with paragraph PLANT MATERIAL. Replacement plant material shall be installed in accordance with paragraph INSTALLATION, and recommendations in paragraph PLANT ESTABLISHMENT PERIOD. Plant material shall be replaced in accordance with paragraph WARRANTY. An extended plant establishment period shall not be required for replacement plant material.

#### 3.9.5 Maintenance Instructions

Written instructions shall be furnished containing drawings and other necessary information for year-round care of the installed plant material; including, when and where maintenance should occur, and the procedures for plant material replacement,.

-- End of Section --

## SECTION 05090

WELDING, STRUCTURAL  
**09/98**

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

## AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC ASD Spec	(1989) Specification for Structural Steel Buildings - Allowable Stress Design, Plastic Design
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## AMERICAN SOCIETY FOR NONDESTRUCTIVE TESTING (ASNT)

ASNT RP SNT-TC-1A	(1996) Recommended Practice SNT-TC-1A
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## AMERICAN WELDING SOCIETY (AWS)

AWS A2.4	(1998) Standard Symbols for Welding, Brazing and Nondestructive Examination
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AWS A3.0	(1994) Standard Welding Terms and Definitions
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AWS D1.1	(1998) Structural Welding Code - Steel
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AWS Z49.1	(1999) Safety in Welding and Cutting and Allied Processes
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## 1.2 DEFINITIONS

Definitions of welding terms shall be in accordance with AWS A3.0.

## 1.3 GENERAL REQUIREMENTS

The design of welded connections shall conform to AISC ASD Spec unless otherwise indicated or specified. Material with welds will not be accepted unless the welding is specified or indicated on the drawings or otherwise approved. Welding shall be as specified in this section, except where additional requirements are shown on the drawings or are specified in other sections. Welding shall not be started until welding procedures, inspectors, nondestructive testing personnel, welders, welding operators, and tackers have been qualified and the submittals approved by the Contracting Officer. Qualification testing shall be performed at or near

the work site. Each Contractor performing welding shall maintain records of the test results obtained in welding procedure, welder, welding operator, and tacker performance qualifications.

#### 1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

##### SD-03 Product Data

Welding Procedure Qualifications; G, A  
Welder, Welding Operator, and Tacker Qualification; GA, A  
Inspector Qualification; GA, A

Copies of the welding procedure specifications; the procedure qualification test records; and the welder, welding operator, or tacker qualification test records.

##### SD-06 Test Reports

Quality Control; GA, A

A quality assurance plan and records of tests and inspections.

#### 1.5 WELDING PROCEDURE QUALIFICATIONS

Except for prequalified (per AWS D1.1) and previously qualified procedures, each Contractor performing welding shall record in detail and shall qualify the welding procedure specification for any welding procedure followed in the fabrication of weldments. Qualification of welding procedures shall conform to AWS D1.1 and to the specifications in this section. Copies of the welding procedure specification and the results of the procedure qualification test for each type of welding which requires procedure qualification shall be submitted for approval. Approval of any procedure, however, will not relieve the Contractor of the sole responsibility for producing a finished structure meeting all the requirements of these specifications. This information shall be submitted on the forms in Appendix E of AWS D1.1. Welding procedure specifications shall be individually identified and shall be referenced on the detail drawings and erection drawings, or shall be suitably keyed to the contract drawings. In case of conflict between this specification and AWS D1.1, this specification governs.

##### 1.5.1 Previous Qualifications

Welding procedures previously qualified by test may be accepted for this contract without requalification if the following conditions are met:

a. Testing was performed by an approved testing laboratory, technical consultant, or the Contractor's approved quality control organization.

b. The qualified welding procedure conforms to the requirements of this specification and is applicable to welding conditions encountered under this contract.

c. The welder, welding operator, and tacker qualification tests conform to the requirements of this specification and are applicable to welding conditions encountered under this contract.

#### 1.5.2 Prequalified Procedures

Welding procedures which are considered prequalified as specified in AWS D1.1 will be accepted without further qualification. The Contractor shall submit for approval a listing or an annotated drawing to indicate the joints not prequalified. Procedure qualification shall be required for these joints.

#### 1.5.3 Retests

If welding procedure fails to meet the requirements of AWS D1.1, the procedure specification shall be revised and requalified, or at the Contractor's option, welding procedure may be retested in accordance with AWS D1.1. If the welding procedure is qualified through retesting, all test results, including those of test welds that failed to meet the requirements, shall be submitted with the welding procedure.

#### 1.6 WELDER, WELDING OPERATOR, AND TACKER QUALIFICATION

Each welder, welding operator, and tacker assigned to work on this contract shall be qualified in accordance with the applicable requirements of AWS D1.1 and as specified in this section. Welders, welding operators, and tackers who make acceptable procedure qualification test welds will be considered qualified for the welding procedure used.

##### 1.6.1 Previous Personnel Qualifications

At the discretion of the Contracting Officer, welders, welding operators, and tackers qualified by test within the previous 6 months may be accepted for this contract without requalification if all the following conditions are met:

a. Copies of the welding procedure specifications, the procedure qualification test records, and the welder, welding operator, and tacker qualification test records are submitted and approved in accordance with the specified requirements for detail drawings.

b. Testing was performed by an approved testing laboratory, technical consultant, or the Contractor's approved quality control organization.

c. The previously qualified welding procedure conforms to the requirements of this specification and is applicable to welding conditions encountered under this contract.

d. The welder, welding operator, and tacker qualification tests

conform to the requirements of this specification and are applicable to welding conditions encountered under this contract.

#### 1.6.2 Certificates

Before assigning any welder, welding operator, or tacker to work under this contract, the Contractor shall submit the names of the welders, welding operators, and tackers to be employed, and certification that each individual is qualified as specified. The certification shall state the type of welding and positions for which the welder, welding operator, or tacker is qualified, the code and procedure under which the individual is qualified, the date qualified, and the name of the firm and person certifying the qualification tests. The certification shall be kept on file, and 3 copies shall be furnished. The certification shall be kept current for the duration of the contract.

#### 1.6.3 Renewal of Qualification

Requalification of a welder or welding operator shall be required under any of the following conditions:

a. It has been more than 6 months since the welder or welding operator has used the specific welding process for which he is qualified.

b. There is specific reason to question the welder or welding operator's ability to make welds that meet the requirements of these specifications.

c. The welder or welding operator was qualified by an employer other than those firms performing work under this contract, and a qualification test has not been taken within the past 12 months. Records showing periods of employment, name of employer where welder, or welding operator, was last employed, and the process for which qualified shall be submitted as evidence of conformance.

d. A tacker who passes the qualification test shall be considered eligible to perform tack welding indefinitely in the positions and with the processes for which he is qualified, unless there is some specific reason to question the tacker's ability. In such a case, the tacker shall be required to pass the prescribed tack welding test.

#### 1.7 INSPECTOR QUALIFICATION

Inspector qualifications shall be in accordance with AWS D1.1. Nondestructive testing personnel shall be qualified in accordance with the requirements of ASNT RP SNT-TC-1A for Levels I or II in the applicable nondestructive testing method. The inspector may be supported by assistant welding inspectors who are not qualified to ASNT RP SNT-TC-1A, and assistant inspectors may perform specific inspection functions under the supervision of the qualified inspector.

#### 1.8 SYMBOLS

Symbols shall be in accordance with AWS A2.4, unless otherwise indicated.

## 1.9 SAFETY

Safety precautions during welding shall conform to AWS Z49.1.

## PART 2 PRODUCTS

### 2.1 WELDING EQUIPMENT AND MATERIALS

All welding equipment, electrodes, welding wire, and fluxes shall be capable of producing satisfactory welds when used by a qualified welder or welding operator performing qualified welding procedures. All welding equipment and materials shall comply with the applicable requirements of AWS D1.1.

## PART 3 EXECUTION

### 3.1 WELDING OPERATIONS

#### 3.1.1 Requirements

Workmanship and techniques for welded construction shall conform to the requirements of AWS D1.1 and AISC ASD Spec. When AWS D1.1 and the AISC ASD Spec specification conflict, the requirements of AWS D1.1 shall govern.

#### 3.1.2 Identification

Welds shall be identified in one of the following ways:

a. Written records shall be submitted to indicate the location of welds made by each welder, welding operator, or tacker.

b. Each welder, welding operator, or tacker shall be assigned a number, letter, or symbol to identify welds made by that individual. The Contracting Officer may require welders, welding operators, and tackers to apply their symbol next to the weld by means of rubber stamp, felt-tipped marker with waterproof ink, or other methods that do not cause an indentation in the metal. For seam welds, the identification mark shall be adjacent to the weld at 3 foot intervals. Identification with die stamps or electric etchers shall not be allowed.

### 3.2 QUALITY CONTROL

Testing shall be done by an approved inspection or testing laboratory or technical consultant; or if approved, the Contractor's inspection and testing personnel may be used instead of the commercial inspection or testing laboratory or technical consultant. The Contractor shall perform visual and radiographic, ultrasonic, magnetic particle, and dye penetrant inspection to determine conformance with paragraph STANDARDS OF ACCEPTANCE.

Procedures and techniques for inspection shall be in accordance with applicable requirements of AWS D1.1, except that in radiographic inspection only film types designated as "fine grain," or "extra fine," shall be employed.

### 3.3 STANDARDS OF ACCEPTANCE

Dimensional tolerances for welded construction, details of welds, and quality of welds shall be in accordance with the applicable requirements of AWS D1.1 and the contract drawings. Nondestructive testing shall be by visual inspection and radiographic, ultrasonic, magnetic particle, or dye penetrant methods. The minimum extent of nondestructive testing shall be random 1 percent of welds or joints, as indicated on the drawings.

#### 3.3.1 Nondestructive Examination

The welding shall be subject to inspection and tests in the mill, shop, and field. Inspection and tests in the mill or shop will not relieve the Contractor of the responsibility to furnish weldments of satisfactory quality. When materials or workmanship do not conform to the specification requirements, the Government reserves the right to reject material or workmanship or both at any time before final acceptance of the structure containing the weldment.

#### 3.3.2 Destructive Tests

When metallographic specimens are removed from any part of a structure, the Contractor shall make repairs. The Contractor shall employ qualified welders or welding operators, and shall use the proper joints and welding procedures, including peening or heat treatment if required, to develop the full strength of the members and joints cut and to relieve residual stress.

### 3.4 GOVERNMENT INSPECTION AND TESTING

In addition to the inspection and tests performed by the Contractor for quality control, the Government will perform inspection and testing for acceptance to the extent determined by the Contracting Officer. The costs of such inspection and testing will be borne by the Contractor if unsatisfactory welds are discovered, or by the Government if the welds are satisfactory. The work may be performed by the Government's own forces or under a separate contract for inspection and testing. The Government reserves the right to perform supplemental nondestructive and destructive tests to determine compliance with paragraph STANDARDS OF ACCEPTANCE.

### 3.5 CORRECTIONS AND REPAIRS

When inspection or testing indicates defects in the weld joints, the welds shall be repaired using a qualified welder or welding operator as applicable. Corrections shall be in accordance with the requirements of AWS D1.1 and the specifications. Defects shall be repaired in accordance with the approved procedures. Defects discovered between passes shall be repaired before additional weld material is deposited. Wherever a defect is removed and repair by welding is not required, the affected area shall be blended into the surrounding surface to eliminate sharp notches, crevices, or corners. After a defect is thought to have been removed, and before rewelding, the area shall be examined by suitable methods to ensure that the defect has been eliminated. Repair welds shall meet the inspection requirements for the original welds. Any indication of a defect shall be regarded as a defect, unless reevaluation by nondestructive

methods or by surface conditioning shows that no unacceptable defect is present.

-- End of Section --

## SECTION 10440A

## INTERIOR SIGNAGE

**06/98**

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

## ALUMINUM ASSOCIATION (AA)

- |           |   |
|-----------|---|
| AA DAF-45 | (1997) Designation System for Aluminum Finishes   |
| AA PK-1   | (1999) Registration Record of Aluminum Association Alloy Designations and Chemical Composition Limits for Aluminum Alloys in the Form of Castings and Ingot |

## AMERICAN ARCHITECTURAL MANUFACTURERS ASSOCIATION (AAMA)

- |          |  |
|----------|--|
| AAMA 605 | (1998) Voluntary Specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels |
|----------|--|

## AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

- |            |   |
|------------|---|
| ANSI Z97.1 | (1984; Rev 1994) Safety Performance Specifications and Methods of Test for Safety Glazing Materials Used in Buildings |
|------------|---|

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

- |             |  |
|-------------|--|
| ASTM B 209  | (1996) Aluminum and Aluminum-Alloy Sheet and Plate   |
| ASTM B 209M | (1995) Aluminum and Aluminum-Alloy Sheet and Plate (Metric)                                |
| ASTM B 221  | (1996) Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes          |
| ASTM B 221M | (1996) Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric) |

ASTM C 1036 (1991; R 1997) Flat Glass

AMERICAN WELDING SOCIETY (AWS)

AWS D1.2 (1997) Structural Welding Code - Aluminum

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (1999) National Electrical Code

## 1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

### SD-02 Shop Drawings

Detail Drawings; G, RE, AE

Drawings showing elevations of each type of sign, dimensions, details and methods of mounting or anchoring, shape and thickness of materials, and details of construction. A schedule showing the location, each sign type, and message shall be included.

### SD-03 Product Data

Installation; FIO

Manufacturer's descriptive data, catalogs cuts, installation and cleaning instructions.

### SD-04 Samples

Interior Signage; G, RE, AE

One sample of each of the following sign types showing typical quality and workmanship. The samples may be installed in the work, provided each sample is identified and location recorded.

- a. Directional sign.
- b. Door identification sign.

Two samples of manufacturer's standard color chips for each material requiring color selection.

### SD-10 Operation and Maintenance Data

Approved Manufacturer's Instructions; FIO  
Protection and Cleaning; FIO

Six copies of operating instructions outlining the step-by-step procedures required for system operation shall be provided. The instructions shall include simplified diagrams for the system as installed. Six copies of maintenance instructions listing routine procedures, repairs, and guides shall be provided. The instructions shall include the manufacturer's name, model number, service manual, parts list, and brief description of all equipment and their basic operating features. Each set shall be permanently bound and shall have a hard cover. The following identification shall be inscribed on the covers: the words "OPERATING AND MAINTENANCE INSTRUCTIONS", name and location of the facility, name of the Contractor, and contract number.

### 1.3 GENERAL

Interior signage shall be of the design, detail, sizes, types, and message content shown on the drawings, shall conform to the requirements specified, and shall be provided at the locations indicated. Signs shall be complete with lettering, framing as detailed, and related components for a complete installation.

#### 1.3.1 Character Proportions and Heights

Letters and numbers on indicated signs in handicapped-accessible buildings, which do not designate permanent rooms or spaces, shall have a width-to-height ratio between 3:5 and 1:1 and a stroke-width-to-height ratio between 1:5 and 1:10. Characters and numbers on indicated signs shall be sized according to the viewing distance from which they are to be read. The minimum height is measured using an upper case letter "X". Lower case characters are permitted. Suspended or projected overhead signs shall have a minimum character height of 3 inches.

#### 1.3.2 Raised and Brailled Characters and Pictorial Symbol Signs (Pictograms)

Letters and numbers on indicated signs which designate permanent rooms and spaces in handicapped-accessible buildings shall be raised 1/32 inch upper case, sans serif or simple serif type and shall be accompanied with Grade 2 Braille. Raised characters shall be at least 5/8 inch in height, but no higher than 2 inches. Pictograms shall be accompanied by the equivalent verbal description placed directly below the pictogram. The border dimension of the pictogram shall be 6 inches minimum in height. Indicated accessible facilities shall use the international symbol of accessibility.

### 1.4 QUALIFICATIONS

Signs, plaques, and dimensional letters shall be the standard product of a manufacturer regularly engaged in the manufacture of such products and shall essentially duplicate signs that have been in satisfactory use at least 2 years prior to bid opening.

### 1.5 DELIVERY AND STORAGE

Materials shall be delivered to the jobsite in manufacturer's original packaging and stored in a clean, dry area in accordance with manufacturer's instructions.

#### 1.6 EXTRA STOCK

The Contractor shall provide 10% extra frames and extra stock of all sign types.

### PART 2 PRODUCTS

#### 2.1 ROOM IDENTIFICATION/DIRECTIONAL SIGNAGE SYSTEM

Signs shall be fabricated of Type MP laminated thermosetting plastic suitable for engraving or acrylic plastic conforming to ANSI Z97.1.

##### 2.1.1 Standard Room Signs

Signs shall consist of matte finish acrylic plastic or laminated thermosetting Type MP plastic. Units shall be frameless. Corners of signs shall be squared.

##### 2.1.2 Changeable Message Strip Signs

Changeable message strip signs shall consist of cast acrylic or laminated thermosetting Type MP plastic captive message slider sign face with message slots and associated end caps, as detailed, for insertion of changeable message strips. Size of signs shall be as shown on the drawings. Individual message strips to permit removal, change, and reinsertion shall be provided as detailed. Corners of signs shall be squared.

##### 2.1.3 Type of Mounting For Signs

Extruded aluminum brackets, mounted as shown, shall be furnished for hanging, projecting, and double-sided signs. Mounting for framed, hanging, and projecting signs shall be by mechanical fasteners. Surface mounted signs shall be provided with 1/16 inch thick vinyl foam tape. Sign inserts shall be provided with 1/16 inch thick foam tape.

##### 2.1.4 Graphics

Signage graphics for modular identification/directional signs shall conform to the following:

Message shall be applied to panel using the silkscreen process. Silkscreened images shall be executed with photo screens prepared from original art. Handcut screens will not be accepted. Original art shall be defined as artwork that is a first generation reproduction of the specified art. Edges and corners shall be clean.

#### 2.2 BUILDING DIRECTORIES

Building directories shall be lobby directories or floor directories, and shall be provided with a changeable directory listing consisting of the

areas, offices and personnel located within the facility. Dimensions, details, and materials of sign shall be as shown on the drawings. Where required, message content shall be as shown on drawings and schedule.

#### 2.2.1 Header Panel

Header panel shall be acrylic with raised acrylic letters or be MP plastic with raised letters.

#### 2.2.2 Doors

##### 2.2.2.1 Door Glazing

Door glazing shall be in accordance with ASTM C 1036, Type 1, Class 1, Quality 3, minimum 1/8 inch thick tempered safety glass.

##### 2.2.2.2 Door Construction

Extruded aluminum door frame shall be of same finish as surrounding frame. Corners shall be mitered, reinforced, and assembled with concealed fasteners. Hinges shall be standard with the manufacturer, in finish to match frames and trim. Glazing shall be set in frame with resilient glazing channels.

##### 2.2.2.3 Door Locks

Door locks shall be manufacturer's standard, and shall be keyed alike.

#### 2.2.3 Fabrication

Extruded aluminum frames and trim shall be assembled with corners reinforced and mitered to a hairline fit, with no exposed fasteners.

#### 2.2.4 Changeable Letter/Message Strip Directory System

Directory shall consist of non-illuminated unit with step or groove, laser or rotary engraved removable name strips. Design of unit shall be as shown in the drawings.

##### 2.2.4.1 Construction

The directory shall be constructed of an aluminum [2] [\_\_\_\_\_] inch deep frame with satin clear anodized finish. Unit shall be surface mounted. Unit shall have a header with lettering as shown. Unit shall have a [3/8] [\_\_\_\_\_] inch face concealed hinge door and locking system with tempered safety glass. Door frame shall be aluminum with satin clear anodized finish.

##### 2.2.4.2 Message Strips

Namesrips shall be updatable by user with coupon book reordering and with 5 to 7 day delivery. Namesrips shall be acrylic sized per drawings.

#### 2.3 ANODIC COATING

Anodized finish shall conform to AA DAF-45 as follows:

Clear (natural) designation AA-M10-C22-A31, Architectural Class II  
0.4 mil or thicker.

## 2.4 FABRICATION AND MANUFACTURE

### 2.4.1 Factory Workmanship

Holes for bolts and screws shall be drilled or punched. Drilling and punching shall produce clean, true lines and surfaces. Exposed surfaces of work shall have a smooth finish and exposed riveting shall be flush. Fastenings shall be concealed where practicable.

### 2.4.2 Dissimilar Materials

Where dissimilar metals are in contact, the surfaces will be protected to prevent galvanic or corrosive action.

## 2.5 COLOR, FINISH, AND CONTRAST

Color shall be as shown on drawings. In buildings required to be handicapped-accessible, the characters and background of signs shall be eggshell, matte, or other non-glare finish. Characters and symbols shall contrast with their background - either light characters on a dark background or dark characters on a light background.

## PART 3 EXECUTION

### 3.1 INSTALLATION

Signs shall be installed in accordance with approved manufacturer's instructions at locations shown on the detail drawings. Signs shall be installed plumb and true at mounting heights indicated, and by method shown or specified. Required blocking shall be installed as detailed. Signs which designate permanent rooms and spaces in handicapped-accessible buildings shall be installed on the wall adjacent to the latch side of the door. Where there is no wall space to the latch side of the door, including at double leaf doors, signs shall be placed on the nearest adjacent wall. Mounting location for such signage shall be so that a person may approach within 3 inches of signage without encountering protruding objects or standing within the swing of a door. Signs on doors or other surfaces shall not be installed until finishes on such surfaces have been installed. Signs installed on glass surfaces shall be installed with matching blank back-up plates in accordance with manufacturer's instructions.

#### 3.1.1 Anchorage

Anchorage shall be in accordance with approved manufacturer's instructions.

Anchorage not otherwise specified or shown shall include slotted inserts, expansion shields, and powder-driven fasteners when approved for concrete; toggle bolts and through bolts for masonry; machine carriage bolts for

steel; lag bolts and screws for wood. Exposed anchor and fastener materials shall be compatible with metal to which applied and shall have matching color and finish. Where recommended by signage manufacturer, foam tape pads may be used for anchorage. Foam tape pads shall be minimum 1/16 inch thick closed cell vinyl foam with adhesive backing. Adhesive shall be transparent, long aging, high tech formulation on two sides of the vinyl foam. Adhesive surfaces shall be protected with a 5 mil green flatstock treated with silicone. Foam pads shall be sized for the signage as per signage manufacturer's recommendations. Signs mounted to painted gypsum board surfaces shall be removable for painting maintenance. Signs mounted to lay-in ceiling grids shall be mounted with clip connections to ceiling tees.

### 3.1.2 Protection and Cleaning

The work shall be protected against damage during construction. Hardware and electrical equipment shall be adjusted for proper operation. Glass, frames, and other sign surfaces shall be cleaned in accordance with the manufacturer's approved instructions.

-- End of Section --

## SECTION 13945

PREACTION SPRINKLER SYSTEMS, FIRE PROTECTION  
04/00

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 47	(1990; R 1995) Ferritic Malleable Iron Castings
ASTM A 47M	(1990; R 1996) Ferritic Malleable Iron Castings (Metric)
ASTM A 53	(199b) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A 135	(1997c) Electric-Resistance-Welded Steel Pipe
ASTM A 183	(1983; R 1998) Carbon Steel Track Bolts and Nuts
ASTM A 536	(1999e1) Ductile Iron Castings
ASTM A 795	(1997) Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless Steel Pipe for Fire Protection Use

## AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B16.1	(1998) Cast Iron Pipe Flanges and Flanged Fittings
ASME B16.9	(1993) Factory-Made Wrought Steel Buttwelding Fittings
ASME B16.11	(1996) Forged Fittings, Socket-Welding and Threaded
ASME B16.21	(1992) Nonmetallic Flat Gaskets for Pipe Flanges
ASME B18.2.1	(1996) Square and Hex Bolts and Screws Inch Series
ASME B18.2.2	(1987; R 1993) Square and Hex Nuts (Inch Series)

## AMERICAN SOCIETY OF SANITARY ENGINEERING (ASSE)

ASSE 1015 (1993) Double Check Backflow Prevention Assembly

## AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA-EWW (1995) Standard Methods for the Examination of Water and Wastewater

AWWA B300 (1992) Hypochlorites

AWWA B301 (1992) Liquid Chlorine

AWWA C104 (1995) Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water

AWWA C110 (1993) Ductile-Iron and Gray-Iron Fittings, 3 In. Through 48 In. (75 mm through 1200 mm), for Water and Other Liquids

AWWA C111 (1995) Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings

AWWA C151 (1996) Ductile-Iron Pipe, Centrifugally Cast, for Water or Other Liquids

AWWA C203 (1997) Coal-Tar Protective Coatings and Linings for Steel Water Pipelines - Enamel and Tape - Hot-Applied

AWWA M20 (1973) Manual: Water Chlorination Principles and Practices

## FACTORY MUTUAL ENGINEERING AND RESEARCH (FM)

FM P7825a (1998) Approval Guide Fire Protection

FM P7825b (1998) Approval Guide Electrical Equipment

## INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C62.41 (1991; R 1995) Surge Voltages in Low-Voltage AC Power Circuits

## MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-71 (1997) Cast Iron Swing Check Valves, Flanges and Threaded Ends

## NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 13 (1999) Installation of Sprinkler Systems

NFPA 24 (1995) Installation of Private Fire Service Mains and Their Appurtenances

NFPA 70 (1999) National Electrical Code

NFPA 72 (1999) National Fire Alarm Code

NFPA 1963 (1998) Fire Hose Connections

NATIONAL INSTITUTE FOR CERTIFICATION IN ENGINEERING TECHNOLOGIES  
(NICET)

NICET 1014-7 (1995) Program Detail Manual for  
Certification in the Field of Fire  
Protection Engineering Technology (Field  
Code 003) Subfield of Automatic Sprinkler  
System Layout

UNDERWRITERS LABORATORIES (UL)

UL Bld Mat Dir (1999) Building Materials Directory

UL Fire Prot Dir (1999) Fire Protection Equipment Directory

## 1.2 GENERAL REQUIREMENTS

Preaction sprinkler system(s) shall be provided in areas indicated on the drawings. The sprinkler system shall provide fire sprinkler protection for the entire area. Except as modified herein, the system shall meet the requirements of NFPA 13 and NFPA 72. The sprinkler system shall be a single interlocked system that requires the actuation of an alarm initiating device to open the water control (deluge) valve. The Contractor shall design any portion of the sprinkler system that are not indicated on the drawings including locating sprinklers, piping, and equipment, and size piping and equipment when this information is not indicated on the drawings or is not specified herein. Pipe sizes which are not indicated on the drawings shall be determined by hydraulic calculations.

### 1.2.1 Hydraulic Design

The system shall be hydraulically designed to discharge a minimum density of gpm per square foot over the hydraulically most demanding [3,000] [\_\_\_\_\_] square feet of floor area. The minimum pipe size for branch lines in gridded systems shall be (1-1/4 inch). Hydraulic calculations shall be in accordance with the Area/Density Method of NFPA 13.

#### 1.2.1.1 Hose Demand

An allowance for exterior hose streams of gpm shall be added to the sprinkler system demand at the fire hydrant shown on the drawings closest to the point where the water service enters the building.

#### 1.2.1.2 Basis for Calculations

The design of the system shall be based on a water supply with a static pressure as indicated. Water supply shall be presumed available at the point of inlet into the building. Hydraulic calculations shall be based [upon the Hazen-Williams formula with a "C" value of 120 for galvanized steel piping, 140 for new cement-lined ductile-iron piping, and 100 for existing underground piping or on operation of the fire pump(s) provided in Section 13920 FIRE PUMPS.

### 1.2.2 Sprinkler Spacing

Sprinklers shall be uniformly spaced on branch lines. Maximum spacing per sprinkler shall not exceed limits specified in NFPA 13 for ordinary occupancy.

### 1.2.3 Control System

The control system shall meet the requirements of NFPA 72. The control panel shall be listed in UL Fire Prot Dir or FM P7825a and FM P7825b for "Releasing Device Service". The control panel and the solenoid valve that activates the water control valves shall be compatible with each other. Compatibility shall be per specific UL listing or FM approval of the control equipment.

#### 1.2.3.1 Power Supply

The primary operating power shall be provided from two single-phase 120 VAC circuits. Transfer from normal to backup power and restoration from backup to normal power shall be fully automatic and shall not initiate a false alarm. Loss of primary power shall not prevent actuation of the respective automatic water control valve upon activation of any alarm initiating device. Backup power shall be provided through use of rechargeable, sealed, lead calcium storage batteries.

#### 1.2.3.2 Circuit Requirements

Alarm initiating devices shall be connected to initiating device circuits (IDC), Style D or to signal line circuits (SLC), Style 6, in accordance with NFPA 72. Alarm notification or indicating appliances shall be connected to indicating appliance circuit (IAC), Style X in accordance with NFPA 72. A separate circuit shall be provided for actuation of each individual automatic water control valve. The circuits that actuate the water control valves shall be fully supervised so that the occurrence of a single open or a single ground fault condition in the interconnecting conductors shall be indicated at the control panel.

### 1.3 SYSTEM OPERATIONAL FEATURES

The system shall include a heat detection system, manual actuation stations, supervisory and alarm switches, alarm notification appliances, control panel and associated equipment. Preaction sprinkler system piping shall be provided with supervisory air pressure not to exceed 30 psig.

#### 1.3.1 System Actuation

Activation of any single heat detector or a single manual actuation station shall actuate alarm zone circuits of the control panel that, in turn, shall actuate the corresponding automatic water control valve. Actuation of the automatic water control valve shall cause water to fill the preaction system piping and be discharged from fused sprinklers.

#### 1.3.2 Alarm Functions

Activation of any heat detector or sprinkler pressure alarm switch or manual actuation station shall cause the illumination of the respective zone annunciator, and activation of the building fire alarm system and transmission of the alarm to the base-wide fire reporting system. Valve tamper alarm shall be monitored by the system control panel and transmitted

to the building fire alarm system as a trouble alarm.

### 1.3.3 Supervisory Functions

The reduction of supervisory air pressure within the sprinkler system piping to less than [10] [\_\_\_\_\_] psi or the occurrence of a single open or a single ground fault in any alarm initiating device circuit, in the automatic water control valve actuation circuit, in any alarm indicating appliance circuit or in other electrically supervised circuit shall cause the individually labelled control panel trouble light to be illuminated, the audible trouble alarm to be activated, and a trouble alarm to be transmitted to the building fire alarm control panel and to base-wide fire reporting system.

### 1.4 COORDINATION OF TRADES

Piping offsets, fittings, and any other accessories required shall be furnished as required to provide a complete installation and to eliminate interference with other construction. Sprinkler shall be installed over and under ducts, piping and platforms when such equipment can negatively effect or disrupt the sprinkler discharge pattern and coverage.

### 1.5 DELIVERY AND STORAGE

All equipment delivered and placed in storage shall be housed in a manner to preclude any damage from the weather, humidity and temperature variations, dirt and dust, or other contaminants. Additionally, all pipes shall either be capped or plugged until installed.

### 1.6 FIELD MEASUREMENTS

After becoming familiar with all details of the work, the Contractor shall verify all dimensions in the field, and shall advise the Contracting Officer of any discrepancy before performing the work.

### 1.7 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

#### SD-02 Shop Drawings

##### Shop Drawings; G RE.

Three copies of the Sprinkler System Drawings, no later than 21 days prior to the start of sprinkler system installation. The Sprinkler System Drawings shall conform to the requirements established for working plans as prescribed in NFPA 13. Drawings shall include plan and elevation views demonstrating that the equipment will fit the allotted spaces with clearance for installation and maintenance. Each set of drawings shall include the following:

- a. Descriptive index of drawings in the submittal with drawings listed in sequence by drawing number. A legend identifying device symbols, nomenclature, and conventions used.

b. Floor plans drawn to a scale not less than 1/8" = 1'-0" which clearly show locations of sprinklers, risers, pipe hangers, seismic separation assemblies, sway bracing, inspector's test connections, drains, and other applicable details necessary to clearly describe the proposed arrangement. Each type of fitting used and the locations of bushings, reducing couplings, and welded joints shall be indicated.

c. Actual center-to-center dimensions between sprinklers on branch lines and between branch lines; from end sprinklers to adjacent walls; from walls to branch lines; from sprinkler feed mains, cross-mains and branch lines to finished floor and roof or ceiling. A detail shall show the dimension from the sprinkler and sprinkler deflector to the ceiling in finished areas.

d. Longitudinal and transverse building sections showing typical branch line and cross-main pipe routing as well as elevation of each typical sprinkler above finished floor.

e. Details of each type of riser assembly; pipe hanger; sway bracing for earthquake protection, and restraint of underground water main at point-of-entry into the building, and electrical devices and interconnecting wiring.

f. Complete point-to-point wiring diagram of the detection and control system. Indicate the detailed interconnection of control panel modules to the devices, the number and size of conductors in each conduit, and size of conduit. Connection points shall be indicated and coordinated with the terminal identification marked on the devices. Complete internal wiring schematic of the control panel and each electrical device shall be provided. Detailed description of the functions of the control panel and each module shall be provided.

As-Built Drawings; , RE.

As-built drawings, at least 14 days after completion of the Final Tests. The Sprinkler System Drawings shall be updated to reflect as-built conditions after all related work is completed and shall be on reproducible full-size mylar film.

#### SD-03 Product Data

Fire Protection Specialist; G RE.

The name and documentation of certification of the proposed Fire Protection Specialists, no later than 14 days after the Notice to Proceed and prior to the submittal of the sprinkler system shop drawings and hydraulic calculations.

Sprinkler System Installer Qualifications; G RE.

The name and documentation of certification of the proposed Sprinkler System Installer, concurrent with submittal of the Fire Protection Specialist Qualifications.

Fire Protection Related Submittals; G RE.

A list of the Fire Protection Related Submittals, no later than 7days after the approval of the Fire Protection Specialist.

Sway Bracing; G RE.

For systems that are required to be protected against damage from earthquakes, load calculations for sizing of sway bracing.

Materials and Equipment; G RE.

Manufacturer's catalog data included with the Sprinkler System Drawings for all items specified herein. The data shall be highlighted to show model, size, options, etc., that are intended for consideration. Data shall be adequate to demonstrate compliance with all contract requirements. In addition, a complete equipment list that includes equipment description, model number and quantity shall be provided.

Hydraulic Calculations; G RE.

Hydraulic calculations, including a drawing showing hydraulic reference points and pipe segments.

Storage Batteries; G RE.

Calculations to substantiate the total requirements for supervisory and alarm power. Ampere-hour requirements for each system component and each control panel component or module, under both normal and alarm conditions shall be included. The battery recharging period shall be included with the calculations.

Spare Parts; G RE.

Spare parts data shall be included for each different item of material and equipment specified. The data shall include a complete list of parts and supplies, with current unit prices and source of supply, and a list of parts recommended by the manufacturer to be replaced after 1 year and 3 years of service. A list of special tools and test equipment required for maintenance and testing of the products supplied by the Contractor shall be included.

Preliminary Tests; G RE.

Proposed procedures for Preliminary Tests, no later than 14 days prior to the proposed start of the tests.

Final Acceptance Tests; G RE.

Proposed procedures for Final Acceptance Tests, no later than 14 days prior to the proposed start of the tests.

Fire Protection Specialist; G RE.

The name and documentation of certification of the proposed Fire Protection Specialists, no later than 14 days after the Notice to Proceed and prior to the submittal of the sprinkler system shop drawings and hydraulic calculations.

Sprinkler System Installer Qualifications; G RE.

The name and documentation of certification of the proposed Sprinkler System Installer, concurrent with submittal of the Fire Protection Specialist Qualifications.

Final Acceptance Tests; G RE.

Proposed date and time to begin Final Acceptance Tests, submitted with the Final Acceptance Test Procedures. Notification shall be provided at least 14 days prior to the proposed start of the test. Notification shall include a copy of the Contractor's Material & Test Certificates.

On-site Training Schedule; G RE.

Proposed On-site Training schedule, at least 14 days prior to the start of related training.

Preliminary Tests; G RE.

Proposed date and time to begin Preliminary Tests, submitted with the Preliminary Tests Procedures.

#### SD-06 Test Reports

Preliminary Tests; G RE.

Three copies of the completed Preliminary Tests Reports, no later than 7 days after the completion of the Preliminary Tests. The Preliminary Tests Report shall include both the Contractor's Material and Test Certificate for Underground Piping and the Contractor's Material and Test Certificate for Aboveground Piping. All items in the Preliminary Tests Report shall be signed by the Fire Protection Specialist.

Final Acceptance Tests; G RE.

Three copies of the completed Final Acceptance Tests Reports, no later than 7 days after the completion of the Final Acceptance Tests. All items in the Final Acceptance Report shall be signed by the Fire Protection Specialist.

#### SD-07 Certificates

Inspection by Fire Protection Specialist; G RE.

Concurrent with the Final Acceptance Test Report, certification by the Fire Protection Specialist that the sprinkler system is installed in accordance with the contract requirements, including signed approval of the Preliminary, Detection and Control Systems, and Final Acceptance Test Reports.

#### SD-10 Operation and Maintenance Data

Preaction Sprinkler System; G RE.

Six manuals listing step-by-step procedures required for system startup, operation, shutdown, and routine maintenance, at least 14

days prior to field training. The manuals shall include the manufacturer's name, model number, parts list, list of parts and tools that should be kept in stock by the owner for routine maintenance including the name of a local supplier, simplified wiring and controls diagrams, troubleshooting guide, and recommended service organization (including address and telephone number) for each item of equipment. Each service organization submitted shall be capable of providing 4 hour onsite response to a service call on an emergency basis.

#### 1.8 HYDRAULIC CALCULATIONS

Hydraulic calculations shall be as outlined in NFPA 13 except that calculations shall be performed by computer using software intended specifically for fire protection system design using the design data shown on the drawings. Software that uses k-factors for typical branch lines is not acceptable. Calculations shall be based on the water supply data shown on the drawings. Calculations shall substantiate that the design area used in the calculations is the most demanding hydraulically. Water supply curves and system requirements shall be plotted on semi-logarithmic graph paper so as to present a summary of the complete hydraulic calculation. A summary sheet listing sprinklers in the design area and their respective hydraulic reference points, elevations, actual discharge pressures and actual flows shall be provided. Elevations of hydraulic reference points (nodes) shall be indicated. Documentation shall identify each pipe individually and the nodes connected thereto. The diameter, length, flow, velocity, friction loss, number and type fittings, total friction loss in the pipe, equivalent pipe length and Hazen-Williams coefficient shall be indicated for each pipe. For gridded systems, calculations shall show peaking of demand area friction loss to verify that the hydraulically most demanding area is being used. Also for gridded systems, a flow diagram indicating the quantity and direction of flows shall be included. A drawing showing hydraulic reference points (nodes) and pipe designations used in the calculations shall be included and shall be independent of shop drawings.

#### 1.9 FIRE PROTECTION SPECIALIST

Work specified in this section shall be performed under the supervision of and certified by the Fire Protection Specialist. The Fire Protection Specialist shall be an individual who is a registered professional engineer and a Full Member of the Society of Fire Protection Engineers or who is certified as a Level IV Technician by National Institute for Certification in Engineering Technologies (NICET) in the Automatic Sprinkler System Layout subfield of Fire Protection Engineering Technology in accordance with NICET 1014-7. The Fire Protection Specialist shall be regularly engaged in the design and installation of the type and complexity of system specified in the Contract documents, and shall have served in a similar capacity for at least three systems that have performed in the manner intended for a period of not less than 6 months.

#### 1.10 SPRINKLER SYSTEM INSTALLER QUALIFICATIONS

Work specified in this section shall be performed by the Sprinkler System Installer. The Sprinkler System Installer shall be regularly engaged in the installation of the type and complexity of system specified in the Contract documents, and shall have served in a similar capacity for at least three systems that have performed in the manner intended for a period of not less than 6 months.

### 1.11 REGULATORY REQUIREMENTS

Compliance with referenced NFPA standards is mandatory. This includes advisory provisions listed in the appendices of such standards, as though the word "shall" had been substituted for the word "should" wherever it appears. Applicable material and installation standards referenced in Appendix A of NFPA 13 and NFPA 24 shall be considered mandatory the same as if such referenced standards were specifically listed in this specification. In the event of a conflict between specific provisions of this specification and applicable NFPA standards, this specification shall govern. All requirements that exceed the minimum requirements of NFPA 13 shall be incorporated into the design. Reference to "authority having jurisdiction" shall be interpreted to mean the Contracting Officer.

## PART 2 PRODUCTS

### 2.1 STANDARD PRODUCTS

Materials and equipment shall be standard products of a manufacturer regularly engaged in the manufacture of such products and shall essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening.

### 2.2 NAMEPLATES

All equipment shall have a nameplate that identifies the manufacturer's name, address, type or style, model or serial number, and catalog number.

### 2.3 REQUIREMENTS FOR FIRE PROTECTION SERVICE

Materials and Equipment shall have been tested by Underwriters Laboratories, Inc. and listed in UL Fire Prot Dir or approved by Factory Mutual and listed in FM P7825a and FM P7825b. Where the terms "listed" or "approved" appear in this specification, such shall mean listed in UL Fire Prot Dir or FM P7825a and FM P7825b.

### 2.4 ABOVEGROUND PIPING COMPONENTS

#### 2.4.1 Steel Pipe

Except as modified herein, steel pipe shall be galvanized conforming to the applicable requirements of NFPA 13, and ASTM A 795, ASTM A 53, or ASTM A 135. Pipe in which threads or grooves are cut shall be Schedule 40 or shall be listed by Underwriters' Laboratories to have a corrosion resistance ratio (CRR) of 1.0 or greater after threads or grooves are cut. Pipe shall be marked with the name of the manufacturer, kind of pipe, and ASTM designation.

#### 2.4.2 Fittings for Non-Grooved Steel Pipe

Fittings shall be galvanized steel conforming to ASME B16.9 or ASME B16.11. Fittings that sprinklers, drop nipples or riser nipples (sprigs) are screwed into shall be threaded type. Plain-end fittings with mechanical couplings, fittings that use steel gripping devices to bite into the pipe and segmented welded fittings shall not be used.

#### 2.4.3 Grooved Mechanical Joints and Fittings

Joints and fittings shall be designed for not less than (175 psi) service and shall be the product of the same manufacturer. Fitting and coupling houses shall be malleable iron conforming to ASTM A 47, Grade 32510; ductile iron conforming to ASTM A 536, Grade 65-45-12. Gaskets shall be of silicon compound and approved for dry fire protection systems. Gasket shall be the flush type that fills the entire cavity between the fitting and the pipe. Nuts and bolts shall be heat-treated steel conforming to ASTM A 183 and shall be cadmium plated or zinc electroplated.

#### 2.4.4 Flanges

Flanges shall conform to NFPA 13 and ASME B16.1. Gaskets shall be non-asbestos compressed material in accordance with ASME B16.21, 1/16 inch thick, and full face or self-centering flat ring type. Bolts shall be squarehead conforming to ASME B18.2.1 and nuts shall be hexagon type conforming to ASME B18.2.2.

#### 2.4.5 Pipe Hangers

Hangers shall be listed in UL Fire Prot Dir or FM P7825a and FM P7825b and of the type suitable for the application, construction, and pipe type and size to be supported.

#### 2.4.6 Valves

##### 2.4.6.1 Control Valve and Gate Valve

Manually operated sprinkler control valve and gate valve shall be outside stem and yoke (OS&Y) type and shall be listed in UL Bld Mat Dir or FM P7825a and FM P7825b.

##### 2.4.6.2 Check Valves

Check valve 2 inches and larger shall be listed in UL Bld Mat Dir or FM P7825a and FM P7825b. Check valves 4 inches and larger shall be of the swing type with flanged cast iron body and flanged inspection plate, shall have a clear waterway and shall meet the requirements of MSS SP-71, for Type 3 or 4.

#### 2.5 AUTOMATIC WATER CONTROL VALVE (DELUGE VALVE)

Automatic water control valve (Deluge Valve) shall be electrically-actuated and rated for a working pressure of . Valve shall be capable of being reset without opening the valve. Electrical solenoid valve used to actuate the water control valve shall be an integral component of the valve or shall be approved for use by the water control valve manufacturer. Solenoid valve shall be rated at 24 volts direct current, and shall be normally closed type that operates when energized. Solenoid valves shall be rated for a maximum pressure differential of 175 psi. Water control valve shall be equipped with a means to prevent the valve from returning to the closed position until being manually reset. Assembly shall be complete with the valve manufacturer's standard trim piping, drain and test valves, pressure gauges, and other required appurtenances. Each assembly shall include an emergency release device for manually tripping the water control valve in the event of a power or other system failure. Device shall be a standard accessory component of the valve manufacturer and shall be labeled as to its function and method of operation. Valves located in hazardous locations shall be approved for the hazard classification of the area where located.

## 2.6 SUPERVISORY AIR SYSTEM

### 2.6.1 Air Compressor

Air compressor shall be single stage oil less type, air cooled, electric-motor driven, equipped with a check valve, centrifugal pressure and moisture unloader, pressure switch for automatic starting and stopping.

Pressure switch shall be set to start the compressor at 20 psi and stop it at 30 psi. A safety relief valve, set to operate at 65 psi, shall be provided. The compressor shall be sized to pressurize the system to 30 psi within 30 minutes.

### 2.6.2 Air Pressure Maintenance Device

Device shall be a pressure regulator that automatically reduces supply air pressure to the minimum pressure required to be maintained in the piping system. The device shall have a cast bronze body and valve housing complete with diaphragm assembly, spring, filter, ball check to prevent backflow, 1/16 inch restriction to prevent rapid pressurization of the system, and adjustment screw. The device shall be capable of reducing maximum inlet pressure of to a fixed outlet pressure adjustable to

### 2.6.3 Air Supply Piping System

Each preaction system shall be equipped with a separate pressure maintenance device, shutoff valve, bypass valve and pressure gauge. Piping shall be galvanized steel in accordance with ASTM A 795 or ASTM A 53.

### 2.6.4 Low Air Pressure Switch

Each preaction system shall be provided with an air pressure switch connected to the control panel. Upon reduction of supervisory air pressure to approximately , the low air pressure switch shall actuate the audible alarm device and a red low-air alarm light on the control panel annunciator.

## 2.7 WATER MOTOR ALARM ASSEMBLY

Assembly shall include a body housing, impeller wheel, drive shaft, striker assembly, gong, wall plate and related components necessary for complete operation. Minimum 20 mm (3/4 inch) galvanized piping shall be provided between the housing and the automatic water control valve. Drain piping from the body housing shall be minimum 25 mm (1 inch) galvanized steel and shall be arranged to drain to the outside of the building. Piping shall be galvanized both on the inside and on the outside surfaces.

## 2.8 SPRINKLERS

Sprinklers for preaction systems shall be automatic, fusible solder or glass bulb type; sprinklers for deluge systems shall be open type without the fusible element. Sprinklers with internal O-rings shall not be used. Sprinklers shall be used in accordance with their listed spacing limitations. Temperature classification shall be ordinary. Sprinklers in high heat areas including attic spaces or in close proximity to unit heaters shall have temperature classification in accordance with NFPA 13. Orifice of extended coverage sprinklers shall not exceed

### 2.8.1 Pendent Sprinkler

Pendent sprinkler shall be of the fusible strut or glass bulb type, recessed quick-response type for the pre-action areas indicated on the drawings, except for the mechanical fan room which will be provided with pendent quick-response type, with nominal 17/32 inch orifice. Pendent sprinklers shall have a stainless steel finish.

## 2.9 DISINFECTING MATERIALS

### 2.8.2 Liquid Chlorine

Liquid chlorine shall conform to AWWA B301.

### 2.8.3 Hypochlorites

Calcium hypochlorite and sodium hypochlorite shall conform to AWWA B300.

## 2.9 ACCESSORIES

### 2.9.1 Sprinkler Cabinet

Spare sprinklers shall be provided in accordance with NFPA 13 and shall be packed in a suitable metal or plastic cabinet. Spare sprinklers shall be representative of, and in proportion to, the number of each type and temperature rating of the sprinklers installed. At least one wrench of each type required shall be provided.

### 2.9.2 Pendent Sprinkler Escutcheon

Escutcheon shall be one-piece metallic type with a depth of less than 3/4 inch and suitable for installation on pendent sprinklers. The escutcheon shall have a factory finish that matches the pendent sprinkler heads.

### 2.9.3 Pipe Escutcheon

Escutcheon shall be polished chromium-plated zinc alloy, or polished chromium-plated copper alloy. Escutcheons shall be either one-piece or split-pattern, held in place by internal spring tension or set screw.

### 2.9.4 Sprinkler Guard

Guard shall be a steel wire cage designed to encase the sprinkler and protect it from mechanical damage. Guards shall be provided on sprinklers located in the Mechanical Fan Room and in the Telcom Equipment Rooms.

### 2.9.5 Identification Sign

Valve identification sign shall be minimum 6 inches wide by 2 inches high with enamel baked finish on minimum 18 gauge steel or 0.024 inch aluminum with red letters on a white background or white letters on red background. Wording of sign shall include, but not be limited to "main drain," "auxiliary drain," "inspector's test," "alarm test," "alarm line," and similar wording as required to identify operational components.

## 2.10 CONTROL PANEL

### 2.10.1 System Zoning

The system shall be zoned with a minimum of one zone valve per floor. All concealed valves shall be clearly provided with visible signs as per NFPA

13.

## 2.11 ALARM INITIATING DEVICES

### 2.11.1 Heat Detectors

Detectors located in areas subject to moisture, exterior atmospheric conditions or hazardous locations as defined in NFPA 70 shall be approved for such locations. Detectors shall be listed or approved for 50 foot spacing between detectors. The detector shall be equipped with an alarm indicating light in its base that lights when the detector is in an alarm condition. Five spare detectors of each type and temperature rating shall be provided.

#### 2.11.1.1 Rate Compensation Detector

Detector shall be of the horizontal spot type with a temperature classification rating of ordinary as defined by NFPA 72. Detectors listed or approved as "rate anticipation" type will be accepted. Detector shall automatically reset when temperature drops below detector temperature rating. Detector shall be hermetically sealed.

#### 2.11.2 Sprinkler Pressure Alarm Switch (Waterflow Alarm)

Pressure switch shall include a metal housing with a neoprene diaphragm, SPDT snap action switches. The switch shall have a service pressure rating of 175 psi. There shall be two SPDT (Form C) contacts factory adjusted to operate at 4 to 8 psi. The switch shall be capable of being mounted in any position in the alarm line trim piping of the alarm check valve.

#### 2.11.3 Valve Supervisory (Tamper) Switch

Switch shall be suitable for mounting to the type of control valve to be supervised open. The switch shall be tamper resistant and contain one set of SPDT (Form C) contacts arranged to transfer upon removal of the housing cover or closure of the valve of more than two rotations of the valve stem.

## 2.12 NOTIFICATION APPLIANCES

Notification appliances shall be suitable for connection to supervised alarm indicating circuits. Appliance shall have a separate screw terminal for each conductor. The surface of the appliance shall be red in color.

### 2.12.1 Alarm Bell

Bell shall be 10 inch diameter, surface-mounted vibrating type with matching back box. Sound output shall be a minimum of 85 DBA at 10 feet. Bell shall operate on nominal 24 VDC. Bells shall have screw terminals for in-out wiring connection. Bells used in exterior locations shall be specifically listed or approved for outdoor use and be provided with metal housing and protective grilles.

### 2.12.2 Alarm Horn

Horn shall be surface mounted, with the matching mounting back box surface mounted vibrating type suitable for use in an electrically supervised circuit. Horns shall operate on nominal 24 VDC and have screw terminals for in-out wiring connection. Sound output shall be a minimum of 85 DBA at 10 feet. Horns used in exterior locations shall be specifically listed

or approved for outdoor use and be provided with metal housing and protective grills.

### 2.13 WIRING

Wiring for alternating current (AC) circuits shall be 12 AWG minimum. Wiring for low voltage direct current (DC) circuits shall be No. 14 AWG minimum. Power wiring (over 28 volts) and control wiring shall be isolated. Wiring shall conform to NFPA 70. System field wiring shall be solid copper and installed in electrical metallic tubing or in metallic conduit, except rigid plastic conduit may be used under slab-on-grade. Conductors shall be color coded. Conductors used for the same function shall be similarly color coded. Wiring color code shall remain uniform throughout the circuit. Pigtail or T-tap connections to alarm initiating, alarm indicating, supervisory, and actuation circuits are prohibited.

## PART 3 EXECUTION

### 3.1 FIRE PROTECTION RELATED SUBMITTALS

The Fire Protection Specialist shall prepare a list of the submittals from the Contract Submittal Register that relate to the successful installation of the sprinkler systems(s). The submittals identified on this list shall be accompanied by a letter of approval signed and dated by the Fire Protection Specialist when submitted to the Government.

### 3.2 INSTALLATION REQUIREMENTS

The installation shall be in accordance with the applicable provisions of publications referenced herein.

### 3.3 INSPECTION BY FIRE PROTECTION SPECIALIST

The Fire Protection Specialist shall inspect the sprinkler system periodically during the installation to assure that the sprinkler system installed in accordance with the contract requirements. The Fire Protection Specialist shall witness the preliminary and final tests, and shall sign the test results. The Fire Protection Specialist, after completion of the system inspections and a successful final test, shall certify in writing that the system has been installed in accordance with the contract requirements. Any discrepancy shall be brought to the attention of the Contracting Officer in writing, no later than three working days after the discrepancy is discovered.

### 3.4 ABOVEGROUND PIPING INSTALLATION

#### 3.4.1 Protection of Piping Against Earthquake Damage

The system piping shall be protected against damage from earthquakes. Seismic protection shall include flexible and rigid couplings, sway bracing, seismic separation assemblies where piping crosses building seismic separation joints, and other features as required by NFPA 13 for protection of piping against damage from earthquakes.

#### 3.4.2 Piping in Exposed Areas

Exposed piping shall be installed so as not diminish exit access widths, corridors, or equipment access. Exposed horizontal piping, including drain piping, shall be installed to provide maximum headroom.

### 3.4.3 Piping in Finished Areas

In areas with suspended or dropped ceilings and in areas with concealed spaces above the ceiling, piping shall be concealed above ceilings. Piping shall be inspected, tested and approved before being concealed. Risers and similar vertical runs of piping in finished areas shall be concealed.

### 3.4.4 Pendent Sprinklers Locations

Sprinklers installed in the pendent position shall be of the listed dry pendent type, unless otherwise indicated. Dry pendent sprinklers shall be of the required length to permit the sprinkler to be threaded directly into a branch line tee. Hangers shall be provided on arm-overs exceeding 12 inches in length. Dry pendent sprinkler assemblies shall be such that sprinkler ceiling plates or escutcheons are of the uniform depth throughout the finished space. Pendent sprinklers in suspended ceilings shall be a minimum of 6 inches from ceiling grid. Recessed pendent sprinklers shall be installed such that the distance from the sprinkler deflector to the underside of the ceiling shall not exceed the manufacturer's listed range and shall be of uniform depth throughout the finished area.

### 3.4.5 Pipe Joints

Pipe joints shall conform to NFPA 13, except as modified herein. Not more than four threads shall show after joint is made up. Welded joints will be permitted, only if welding operations are performed as required by NFPA 13 at the Contractor's fabrication shop, not at the project construction site.

Flanged joints shall be provided where indicated or required by NFPA 13. Grooved pipe and fittings shall be prepared in accordance with the manufacturer's latest published specification according to pipe material, wall thickness and size. Grooved couplings and fittings shall be from the same manufacturer.

### 3.4.6 Reducers

Reductions in pipe sizes shall be made with one-piece tapered reducing fittings. The use of grooved-end or rubber-gasketed reducing couplings will not be permitted. When standard fittings of the required size are not manufactured, single bushings of the face type will be permitted. Where used, face bushings shall be installed with the outer face flush with the face of the fitting opening being reduced. Bushings shall not be used in elbow fittings, in more than one outlet of a tee, in more than two outlets of a cross, or where the reduction in size is less than 1/2 inch.

### 3.4.7 Pipe Penetrations

Cutting structural members for passage of pipes or for pipe-hanger fastenings will not be permitted. Pipes that must penetrate concrete or masonry walls or concrete floors shall be core-drilled and provided with pipe sleeves. Each sleeve shall be Schedule 40 galvanized steel, ductile iron or cast iron pipe and shall extend through its respective wall or floor and be cut flush with each wall surface. Sleeves shall provide required clearance between the pipe and the sleeve per NFPA 13. The space between the sleeve and the pipe shall be firmly packed with mineral wool insulation. Where pipes penetrate fire walls, fire partitions, or floors, pipes shall be fire stopped in accordance with Section 07840 FIRESTOPPING. In penetrations that are not fire-rated or not a floor penetration, the space between the sleeve and the pipe shall be sealed at both ends with

plastic waterproof cement that will dry to a firm but pliable mass or with a mechanically adjustable segmented elastomer seal.

#### 3.4.8 Escutcheons

Escutcheons shall be provided for pipe penetration of ceilings and walls. Escutcheons shall be securely fastened to the pipe at surfaces through which piping passes.

#### 3.4.9 Inspector's Test Connection

Unless otherwise indicated, test connection shall consist of 1 inch pipe connected to the remote branch line; a test valve located approximately above the floor; a smooth bore brass outlet equivalent to the smallest orifice sprinkler used in the system; and a painted metal identification sign affixed to the valve with the words "Inspector's Test." The discharge orifice shall be located outside the building wall directed so as not to cause damage to mechanical and electrical equipment, adjacent construction or landscaping during full flow discharge.

#### 3.4.10 Drains

Main drain piping shall be provided to discharge at a safe point outside the building and away from mechanical and electrical equipment. Auxiliary drains shall be provided as indicated and as required by NFPA 13. When the capacity of trapped sections of pipe is less than 3 gallons, the auxiliary drain shall consist of a valve not smaller than 1/2 inch and a plug or nipple and cap. When the capacity of trapped sections of piping is more than 3 gallons, the auxiliary drain shall consist of two 1 inch valves and one 2 x 12 inch condensate nipple or equivalent, located in an accessible location. Tie-in drains shall be provided for multiple adjacent trapped branch pipes and shall be a minimum of 1 inch in diameter. Tie-in drain lines shall be pitched a minimum of 1/2 inch per 10 feet.

#### 3.4.11 Identification Signs

Signs shall be affixed to each control valve, inspector test valve, main drain, auxiliary drain, test valve, and similar valves as appropriate or as required by NFPA 13. Hydraulic design data nameplates shall be permanently affixed to each sprinkler riser as specified in NFPA 13.

### 3.5 ELECTRICAL WORK

Unless otherwise specified herein, power supply equipment and wiring shall be in accordance with Section 16415 ELECTRICAL WORK, INTERIOR.

#### 3.5.1 Overcurrent and Surge Protection

All equipment connected to alternating current circuits shall be protected from surges per IEEE C62.41 and NFPA 70. Cables and conductors that serve as communications links, except fiber optics, shall have surge protection circuits installed at each end. Fuses shall not be used for surge protection.

#### 3.5.2 Grounding

Grounding shall be provided to building ground.

#### 3.5.3 Wiring

System field wiring shall be installed in 3/4 inch minimum diameter electrical metallic tubing or metallic conduit. Wiring for the sprinkler system fire detection and control system shall be installed in tubing or conduits dedicated for that use only and not installed in conduit, outlet boxes or junction boxes which contain lighting and power wiring or equipment. Circuit conductors entering or leaving any mounting box, outlet box enclosure or cabinet shall be connected to screw terminals with each terminal marked and labeled in accordance with the wiring diagram. No more than one conductor shall be installed under any screw terminal.

Connections and splices shall be made using screw terminal blocks. The use of wire nut type connectors is not permitted. Wiring within any control equipment shall be readily accessible without removing any component parts.

Conductors shall be color-coded and shall be identified within each enclosure where a connection or termination is made. Conductor identification shall be by plastic-coated, self-sticking, printed markers or by heat-shrink type sleeves. Circuits shall be wired to maintain electrical supervision so that removal of any single wire from any device shall cause a "trouble" condition on the control panel.

#### 3.5.4 Detectors

Detectors shall be ceiling-mounted per NFPA 72 and shall be at least 12 inches from any part of any lighting fixture. Detectors shall be located at least 3 feet from diffusers of air handling systems. Each detector shall be provided with appropriate mounting hardware as required by its mounting location.

#### 3.5.5 Notification Appliances

Notification appliances shall be mounted a minimum of 8 feet above the finished floor unless limited by ceiling height.

#### 3.6 DISINFECTION

After all system components are installed and hydrostatic test(s) are successfully completed, each portion of the sprinkler system to be disinfected shall be thoroughly flushed with potable water until all entrained dirt and other foreign materials have been removed before introducing chlorinating material. Flushing shall be conducted by removing the flushing fitting of the cross mains and of the grid branch lines, and then back-flushing through the sprinkler main drains. The chlorinating material shall be hypochlorites or liquid chlorine. Water chlorination procedure shall be in accordance with AWWA M20. The chlorinating material shall be fed into the sprinkler piping at a constant rate of 50 parts per million (ppm). A properly adjusted hypochlorite solution injected into the system with a hypochlorinator, or liquid chlorine injected into the system through a solution-fed chlorinator and booster pump shall be used. Chlorination application shall continue until the entire system is filled. The water shall remain in the system for a minimum of 24 hours. Each valve in the system shall be opened and closed several times to ensure its proper disinfection. Following the 24-hour period, no less than 25 ppm chlorine residual shall remain in the system. The system shall then be flushed with clean water until the residual chlorine is reduced to less than one part per million. Samples of water in disinfected containers for bacterial examination will be taken from several system locations which are approved by the Contracting Officer. Samples shall be tested for total coliform organisms (coliform bacteria, fecal coliform, streptococcal, and other bacteria) in accordance with AWWA-EWW. The testing method shall be either

the multiple-tube fermentation technique or the membrane-filter technique. The disinfection shall be repeated until tests indicate the absence of coliform organisms (zero mean coliform density per 100 milliliters) in the samples for at least 2 full days. The system will not be accepted until satisfactory bacteriological results have been obtained. After the successful completion, all sprinklers or plugs and gravity flush all drops or trapped piping.

### 3.7 PIPE COLOR CODE MARKING

Color code marking of piping shall be as specified in Section 09900 PAINTING, GENERAL.

### 3.8 PRELIMINARY TESTS

The system including the underground water mains, the aboveground piping, detectors and control system and system components shall be tested to assure that equipment and components function as intended. The underground and aboveground interior piping systems and attached appurtenances subjected to system working pressure shall be tested in accordance with NFPA 13 and NFPA 24. Upon completion of specified tests, the Contractor shall complete certificates as specified in paragraph SUBMITTALS.

#### 3.8.1 Aboveground Piping

##### 3.8.1.1 Hydrostatic Testing

Aboveground piping shall be hydrostatically tested in accordance with NFPA 13 at not less than 200 psi or 50 psi in excess of maximum system operating pressure and shall maintain that pressure without loss for 2 hours. There shall be no drop in gauge pressure or visible leakage when the system is subjected to the hydrostatic test. The test pressure shall be read from a gauge located at the low elevation point of the system or portion being tested.

##### 3.8.1.2 Air Pressure Test

As specified in NFPA 13, an air pressure leakage test at 50 psi shall be conducted for 24 hours. There shall be no drop in gauge pressure in excess of 1.5 psi for the 24 hours. This air pressure test is in addition to the required hydrostatic test.

#### 3.8.2 Detection and Control System Tests

Upon completion of the installation, the detection and control system shall be subjected to functional and operational performance tests including tests of each installed initiating device, system actuation device and notification appliance. The control system tests specified in paragraph FINAL ACCEPTANCE TESTS shall be conducted to ensure that the system is completely functional and that wiring has been properly connected. If deficiencies are found, corrections shall be made and the system shall be retested to assure that the systems have no deficiencies.

#### 3.8.3 Automatic Water Control Valve Test

Each water control valve shall be independently trip-tested in accordance with the manufacturer's published instructions. Each valve shall be electrically trip-tested by actuating a respective heat detector and a manual actuation station connected to the control panel and a manual

actuation device that is part of the valve trim. A full-flow main drain test shall be made. For preaction systems with supervisory air, the air pressure shall be reduced to verify proper operation of the air supply system and associated supervisory alarm devices.

### 3.9 FINAL ACCEPTANCE TESTS

Final Acceptance Test shall begin only when the Preliminary Test Report has been approved. The Fire Protection Specialist shall conduct the Final Acceptance Test and shall provide a complete demonstration of the operation of the system. This shall include operation of control valves and flowing of inspector's test connections to verify operation of associated waterflow alarm switches. After operation of control valves has been completed, the main drain test shall be repeated to assure that control valves are in the open position. Each system shall be completely drained after each trip test. The system air supply system shall be tested to verify that system pressure is restored in the specified time. In addition, the Fire Protection Specialist shall have available copies of as-built drawings and certificates of tests previously conducted. The installation shall not be considered accepted until identified discrepancies have been corrected and test documentation is properly completed and received. After the system has been tested and drained, the system shall be drained periodically for at least 2 weeks until it can be assured that water from the system has been removed.

#### 3.9.1 Control System Test

Testing shall be in accordance with NFPA 72. The test shall include the following:

- a. Visual inspection of wiring connections.
- b. Opening the circuit at each alarm initiating device, solenoid valve, and notification appliance to test the wiring and supervisory features.
- c. Test of each function of the control panel.
- d. Test of each circuit in the normal, open and ground fault modes.
- e. Test of each initiating device in both normal and trouble conditions.
- f. Test of each control circuit and device.
- g. Test of each alarm notification appliance.
- h. Test of the battery charger and batteries.
- i. Operational tests under emergency power supply, including activation of connected alarm notification appliances for the specified time period.

#### 3.9.2 Trip-tests of Automatic Water Control Valves

Each water control valve shall be independently trip-tested in accordance with the manufacturer's published instructions. Each valve shall be electrically trip-tested by actuating a respective heat detector, a manual actuation station connected to the system control panel and the manual

release which is part of the valve trim. Each valve shall be returned to normal condition after each test. Prior to trip testing sprinkler deluge system, precautionary steps shall be taken to prevent water damage to the building and equipment from sprinkler discharge. Control valves on preaction systems shall remain open until piping is filled with water.

### 3.9.3 Tests of Supervisory Air System

Preaction system supervisory air pressure shall be reduced from the normal system pressure to the point at which a low-pressure alarm is sounded. Air pressure shall be restored to verify trouble signal restoration. Automatic start/stop features of air compressor shall be tested.

-- End of Section --

## SECTION 14240

ELEVATORS, HYDRAULIC  
10/93

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 53/A 53M	(1999b) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A 106	(1999e1) Seamless Carbon Steel Pipe for High-Temperature Service
ASTM A 176	(1999) Stainless and Heat-Resisting Chromium Steel Plate, Sheet, and Strip
ASTM A 366/A 366M	(1997e1) Steel, Sheet, Carbon, Cold-Rolled, Commercial Quality
ASTM A 568/A 568M	(1998e1) Steel, Sheet, Carbon, and High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled
ASTM A 569/A 569M	(1998) Commercial Steel (CS) Sheet and Strip, Carbon (0.15 Maximum Percent), Hot-Rolled
ASTM D 92	(1998a) Flash and Fire Points by Cleveland Open Cup (IP36/84(89))
ASTM E 84	(1999) Surface Burning Characteristics of Building Materials

## ASME INTERNATIONAL (ASME)

ASME A17.1	(1998a) Safety Code for Elevators and Escalators
ASME A17.2.2	(1998) Inspectors' Manual for Hydraulic Elevators
ASME B16.11	(1996) Forged Fittings, Socket-Welding and Threaded

ASME B31.1 (1998) Power Piping

ASME QEI-1 (1997) Standard for the Qualification of  
Elevator Inspectors

CODE OF FEDERAL REGULATIONS (CFR)

36 CFR 1191 Americans with Disabilities Act (ADA)  
Accessibility Guidelines for Buildings and  
Facilities

ENGINEERING TECHNICAL INSTRUCTIONS AND ENERGY SAVINGS ANALYSIS

TI 809-04 (1998) Seismic Design for Buildings

FEDERAL STANDARDS (FED-STD)

FED-STD 795 (Basic) Uniform Federal Accessibility  
Standards

INTERNATIONAL CONFERENCE OF BUILDING OFFICIALS (ICBO)

ICBO Bldg Code (1997) Uniform Building Code (3 Vol.)

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA LD 3 (1995) High-Pressure Decorative Laminates

NEMA MG 1 (1998) Motors and Generators

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (1999) National Electrical Code

NFPA 252 (1999) Fire Tests of Door Assemblies

## 1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-01 Data

Training Data; G, RE.

Information describing the training course for operating personnel, training aids and samples of materials to be used, training schedules, and notification of training.

Elevator System; G, AE.

A complete list of equipment and material, including illustrations, schedules, manufacturer's descriptive data and technical literature, performance charts, catalog cuts, installation instructions, brochures, diagrams, and other information required for fabrication and installation of the equipment. Data shall include calculations for reaction loads imposed on building by elevator systems and to demonstrate that the proposed elevator system conforms to paragraph SEISMIC REQUIREMENTS. Certified copies of list reports may be submitted in lieu of calculations. Calculations to demonstrate compliance with ASME A17.1, Rule XXIV shall be included. Spare parts data for each different item of material and equipment specified, after approval of detail drawings and not later than 4 weeks prior to date of beneficial occupancy. Data shall include a complete list of parts and supplies, with current unit prices and source of supply, and a list of parts recommended to be replaced and replacement interval required. Data shall include appropriate sizing of electrical protective devices.

#### SD-04 Drawings

Elevator System; G, AE.

Detail drawings including dimensioned layouts in plan and elevation showing the arrangement of elevator equipment, anchorage of equipment, clearances for maintenance and operation; and details on hoistway, doors and frames, operation and signal stations, controllers, motors, guide rails and brackets, cylinder, and points of interface with normal power fire alarm system, HVAC or exhaust systems, and interface with emergency power systems. Drawings shall show any revised building electrical system required to make supplied elevator system function as specified. Drawings shall contain complete wiring diagrams showing electrical connections and other details required to demonstrate sequence of operation and functions of system devices. Drawings shall include the appropriate sizing of electrical protective devices which are frequently different from National Electrical Code standard sizes.

#### SD-06 Instructions

Framed Instructions; G, RE.

Diagrams, instructions, and other sheets proposed for posting.

#### SD-08 Statements

Qualification Certificates; G, RE.

Certificates of experience of elevator mechanics employed to install, supervise and test the elevator shall certify mechanics to have not less than 5 years experience installing, supervising and testing elevators of the type and rating specified. Certificate shall certify that elevator system installer is acceptable to elevator manufacturer prior to installation of elevators.

#### SD-09 Reports

Testing; G, RE.

Test reports in booklet form showing all field tests performed to adjust each component and all field tests performed to prove compliance with the specified performance criteria, upon completion and testing of installed system.

#### SD-14 Samples

Finishes; G, RE.

Samples of materials and products requiring color or finish selection.

#### SD-18 Records; G, RE

Test Procedures; G, RE

A plan detailing the testing procedures shall be submitted 60 days prior to performing the elevator tests.

#### SD-19 Operation and Maintenance Manuals

Elevator System; G, RE.

Six copies of operation manual outlining the step-by-step procedures for system startup, operation and shutdown. Manuals shall include manufacturer's name, model number, service manual, parts list and brief description of all equipment, including basic operating features. Six copies of maintenance manual listing routine maintenance procedures, possible breakdowns and repairs, and troubleshooting guides. Manuals shall include equipment layout and complete wiring and control diagrams of the system as installed. Operation and maintenance manuals shall be approved prior to training course.

### 1.3 QUALIFICATIONS

Hydraulic elevator shall be pre-engineered holeless type elevator system and provided by a company regularly engaged in the manufacture of elevator systems. The manufacturer shall either install the elevator system or provide letter of endorsement certifying that the elevator-system installer is acceptable to the manufacturer.

### 1.4 REGULATORY REQUIREMENTS

Design and fabrication shall be in accordance with ASME A17.1. The car shall have the capacity to lift a live load, exclusive of the car, at a speed as specified in the following schedule. The approximate travel, terminal floors, number of stops and openings, and the car sizes shall be as shown in the schedule. The elevators shall serve the floors with stops and openings in accordance with the requirements indicated. Elevators shall provide accessibility and usability for physically handicapped in accordance with the requirements for the handicapped in FED-STD 795 and 36 CFR 1191.

## 1.4.1 Elevator Schedule (Passenger)

Number of Elevators Required: [\_\_\_\_\_]   
Service: [Passenger] [Hospital service]   
Capacity: [\_\_\_\_\_] pounds   
Speed: [\_\_\_\_\_] fpm (full load up)   
(150 fpm downspeed)   
Platform Size: [\_\_\_\_\_] wide by [\_\_\_\_\_] deep   
Clear Car Inside: [\_\_\_\_\_] wide by [\_\_\_\_\_] deep   
Net Travel: [\_\_\_\_\_]   
Landings: [\_\_\_\_\_]   
Openings: Front [\_\_\_\_\_]   
Openings: Rear [\_\_\_\_\_]   
Entrance Type: [Center-opening   
Horizontal-sliding]   
[Single-speed   
Horizontal-sliding]   
[Two-speed   
Horizontal-sliding]

## 1.5 DESIGNATED LANDING

For the purposes of firefighter's service and emergency operations, as required by Section 211, ASME A17.1, the designated landing or level shall be the first floor. The alternate landing or level shall be the second floor.

## 1.6 DELIVERY AND STORAGE

All equipment delivered and placed in storage shall be stored with protection from the weather, excessive humidity and excessive temperature variations; and dirt, or other contaminants.

## 1.7 FIELD MEASUREMENTS

The Contractor shall become familiar with all details of the work, verify all dimensions in the field and advise the Contracting Officer of any discrepancy before performing any work.

## 1.8 WARRANTY

Warranty service shall be provided for each elevator for a period of 12 months after date of acceptance by Contracting Officer. Warranty service

shall be performed only by trained elevator mechanics during regular working hours and shall include manufacturer's warranty requirements including but not limited to adjusting, lubricating and cleaning of equipment and furnishing supplies and parts to keep elevator in operation, except such parts made necessary by misuse, accident or negligence not caused by the Contractor. Testing and adjustments shall be in accordance with the applicable provisions of ASME A17.1 and ASME A17.2.2. Emergency callback service shall be included and available 24 hours a day, 7 days per week, with an initial telephone response time of 1 hour and a response time of 4 hours for a mechanic to the site. Inspection and service for fire service operation seismic requirements shall be performed every 6 months. Documentation of inspection and testing, and certification of successful operation shall be provided with each unit.

## PART 2 PRODUCTS

### 2.1 GENERAL EQUIPMENT REQUIREMENTS

#### 2.1.1 Standard Products

Material and equipment shall be the standard products of manufacturers regularly engaged in the fabrication of elevators and/or elevator parts, and shall essentially duplicate items which have been in satisfactory use for at least 2 years prior to bid opening. Equipment shall be supported by a service organization that is available 24 hours a day, 7 days per week, with a response time of 4 hours.

#### 2.1.2 Nameplates

Each major item of equipment shall have the manufacturer's name, address, type or style, model or serial number, catalog number, and electrical and mechanical characteristics on a plate secured to the item of equipment.

#### 2.1.3 Special Tools

One set of special tools, calibration devices, and instruments required for operation, calibration, and maintenance of the equipment shall be provided.

#### 2.1.4 Electrical Work

Changes to the electrical distribution system required for coordination with elevator equipment shall be performed and coordinated by Contractor, at Contractor's expense. Electrical service for elevator machines shall be 480 volt, 60-Hertz, 3-phase, 4 wire solid neutral grounded alternating current. Electric service for elevator car lighting shall be 120-volt, single-phase, 60-Hertz grounded service. Electrical work shall conform to requirements in Section 16415 ELECTRICAL WORK, INTERIOR. A disconnect switch that will shut off power to the elevator car lighting shall be provided in the elevator machine room adjacent to the elevator control panel. A telephone junction box and an elevator car lighting junction box shall be provided adjacent to each controller. A single-phase electric circuit with grounded connection for video monitor shall be provided in machine room.

### 2.1.5 Use of Asbestos Products

Materials and products required for manufacturing and installing elevators shall not contain asbestos.

## 2.2 MISCELLANEOUS MATERIALS

### 2.2.1 Materials for Car Enclosures

Materials for car enclosures shall meet flame spread rating 0 to 75 and smoke development 0 to 450 as tested in accordance with requirements of ASTM E 84 as established by ASME A17.1, Rule 204.2.

### 2.2.2 Structural Steel

Structural steel shall be hot-rolled commercial quality carbon steel, pickled, oiled, complying with ASTM A 569/A 569M and ASTM A 568/A 568M.

### 2.2.3 Cold-Rolled Sheet Steel

Sheet steel shall be cold-rolled commercial quality low carbon steel, Class 1, exposed matte finish, oiled, complying with ASTM A 366/A 366M and ASTM A 568/A 568M.

### 2.2.4 Stainless Steel

Stainless steel shall be ASTM A 176 Type 302/304, austenitic, corrosion-resistant, with grain of belting in the direction of longest dimension. Surfaces shall be smooth and without waves and shall be in compliance with ASTM A 366/A 366M.

## 2.3 PASSENGER ELEVATOR CAR

### 2.3.1 Car Fronts

Fronts for passenger elevators shall be combination door post and return panels manufactured of 14 gauge stainless steel provided with necessary cutouts for operating devices. Car operating panel shall be recessed into front return panel with surface-applied operating panel cover. Position indicator in front return shall be recessed with a surface-applied cover plate.

### 2.3.2 Car Doors

Car doors for passenger elevators shall be constructed from 16 gauge sheet steel. Each door shall be sound-deadened and reinforced to receive required operating mechanism and hardware, and have two removable door guides per panel. Seams, screws or binding strips shall not be visible from within the car. Threshold shall be extruded aluminum with grooves for door guides. Exposed steel shall be finished with rust-inhibitive primer and baked-enamel in a color to be selected, unless otherwise specified. Car doors shall be equipped with a proximity-type infrared protective device having the following operation:

- a. When doors are in full-open position, doors shall be unable to initiate closing if a person comes within detection zone. Detection zone moves with doors, so that if a passenger or object enters the zone after doors have begun to close, doors shall stop, then reverse to reopen. Doors shall reclose after a brief time. A passenger entering or leaving cars shall not cause doors to reopen unless doors reach a predetermined proximity to passenger.
- b. After a stop is made, doors shall remain open for a time to permit passenger transfer, after which doors shall close automatically. This time interval shall be less for a car call than for a hall call or a coincident car/hall call.
- c. If there is either a hall call anywhere in the group or a car call in the car in question and doors are prevented from closing for a fixed time period, door protective device shall be rendered inoperative, a buzzer shall sound in car and doors shall close at approximately half speed. Normal door operation shall resume at next landing reached by car.

#### 2.3.3 Car Platform

Car platform for passenger elevators shall be fabricated from steel plates secured to a steel frame. Steel car platforms shall be assembled into a one-piece platform with top and bottom steel plates welded to structural steel frame and covered with felt and sound-isolation.

#### 2.3.4 Sling

Sling for passenger elevators shall be constructed of heavy steel stiles properly affixed to a steel crosshead and bolster with adequate bracing members to remove all strain from car enclosure. Steel bumpers shall be furnished for fastening sling to plunger.

#### 2.3.5 Walls

Walls for passenger elevators shall be 7 feet 11-1/2 inches high from floor to the underside of lighting fixtures. Side and rear panels shall be 16 gauge sheet steel panels. [Side and rear removable panels shall be applied to car walls and shall be manufactured from 3/4 inch plywood or composition board finished on front, back and edges faced with plastic laminate conforming to NEMA LD 3, general purpose type.] Panels shall be mounted on car walls in a manner permitting their reversing. Panels shall be evenly spaced with not less than two panels on each side and three panels at rear with 3/8 inch separations backed up with stainless steel dividers or reveal standard with manufacturer. Vent around base shall be concealed behind removable panels.

#### 2.3.6 Car Top, Ceiling and Light Fixtures

Car top for passenger elevators shall be manufactured from 12 gauge sheet steel and shall be not less than 5-1/2 inches high with drop-ceiling and light fixtures. Ceiling shall be [ 1/8 inch thick translucent white plastic fire-retardant light diffuser supported by polished aluminum

perimeter frame and dividers to form drop-ceiling light fixture. Fluorescent light fixtures shall be dual lamp with quick-starting high-power factor, Class P ballasts with safety lamp guard clamps on fluorescent tubes. Light level shall average at least [10] [\_\_\_\_\_] footcandles measured at the car threshold, with the door closed. A part of car light fixture shall be removable to permit use of the emergency exit panel in top of car.

#### 2.3.7 Emergency Exit

Car top for passenger elevators shall be manufactured with a hinged emergency exit panel of 12 gauge steel which opens up to clear the crosshead and car door operator. Emergency exit panel shall be hinged on counterweight side and held in place with nonremovable fastening devices at each corner, and be openable from top of car only. A minimum of two sides of exit panel shall lap exit opening by 1 inch. Exits shall be equipped with electrical contacts which will prevent operation of car when the exit door is open and cause the alarm bell to ring.

#### 2.3.8 Floor Finish

Floor finish for passenger elevators shall be finished with resilient tile flooring not less than 3/16 inch thick or flexible type homogeneous vinyl tile not less than 1/8 inch thick as specified in Section 09650 RESILIENT FLOORING. Tile shall be laid flush with the extruded aluminum platform threshold.

#### 2.3.9 Base

Base for passenger elevators shall be plastic laminate, 6 inches high.

#### 2.3.10 Handrails

Handrails for passenger elevators shall be mounted on each wall and shall comply with ASME A17.1, FED-STD 795 and 36 CFR 1191. For elevators with two-speed horizontal-slide openings, handrails shall be turned back to wall.

#### 2.3.11 Exhaust Fan

Exhaust fan for passenger elevators shall be two-speed exhaust type ventilating unit mounted in car ceiling and shall be provided with a stainless steel grille. Units shall be suitably isolated from car ceiling and shall provide at top speed of a minimum of 6 air changes per hour for car volume and car occupancy. Switches for the operation of the exhaust unit shall be located in car station locked cabinet or key-switched.

#### 2.3.12 Communications

A telephone system in stainless steel cabinet shall be provided for passenger elevators. A vandal-resistant speaker type intercom with push-buttons to activate shall be installed in car station behind a stainless steel perforated grille and connected to a programmable auto-dialer located in machine room. Auto-dialer shall be provided with a solid-state charger unit which will automatically provide emergency power

and an immediate transfer in the event of failure of normal power supply. The push-button located in car station or in separate cabinet shall be at the prescribed handicapped height and shall be identified as "EMERGENCY PHONE PUSH TO ACTIVATE". The entire communication assembly shall be approved for an elevator installation. The push button telephone shall comply with FED-STD 795 and 36 CFR 1191. The telephone communication shall not be terminated until one of the communicating parties hangs up the receiver or manually disconnects the communication link.

#### 2.3.13 Car Emergency Lighting System

Emergency car lighting system for passenger elevators shall consist of an emergency power pack on top of the elevator and a remote lighting fixture inside elevator car located in car operating panel.

##### 2.3.13.1 Power Pack

Power pack for emergency lighting system shall be a sealed lead-cadmium or nickel-cadmium 6-volt rechargeable batteries with solid-state controls and an integral regulating charger connected to normal power supply. Power pack unit shall contain the following:

- a. Minimum 6 inch diameter alarm bell connected to the elevator alarm and emergency push-button.
- b. Top of car light fixture with protective wire guard.
- c. Testing circuit and pilot light.
- d. Low-wattage pilot light indicator.
- e. Battery low-voltage disconnect.

##### 2.3.13.2 Emergency Light Fixture

Emergency light fixture shall be located in car station inside elevator car, with flush-mounted lens and shall consist of the following:

- a. A minimum of two lamps capable of providing a minimum level of illumination of 1.0 footcandle at a point 4 feet above the floor, 1 foot in front of car station.
- b. Steel fixture frame with chrome finish.
- c. Frosted acrylic lens, 1/4 inch.

##### 2.3.13.3 Remote Light Fixture

Upon interruption of normal power, remote light fixture for passenger elevators shall automatically and immediately illuminate and permit operation of alarm bell, subject to activation of emergency stop-switch or alarm button. Emergency power pack shall be capable of providing a minimum of 1 hour emergency bell operation and 4 hours of continuous illumination.

#### 2.3.14 Protection Pads

Car shall be provided with wall protection pads with inconspicuous stainless steel pad hooks spaced not over 18 inches apart near the ceiling. Pads shall be heavy-quality fire-retardant treated canvas with two layers of sewn cotton batting with metal eyelets for each pad hook. Pads shall cover entire wall surface except operating devices. Pads shall be flame retardant in accordance with ASME A17.1, Rule 204.2.

#### 2.3.15 Certificate Frame

A stainless steel certificate frame with translucent plexiglass lens of the appropriate size to receive certificate issued by inspecting agency shall be provided. Frame shall be engraved to show name of manufacturer, carrying capacity in pounds and maximum number of persons allowed.

#### 2.3.16 Car Guide Shoes

Guide shoes for passenger elevators shall be the adjustable mounting type on each side of car. Shoes shall be rigidly secured in accurate alignment at top and bottom of car frame. Flexible type sliding guide shoes shall consist of a swivel-type shoe, assembled on a metal base with provisions for self-alignment. Each shoe shall be provided with renewable gibs. Car guide shoes shall be adjustable for side play between guide rails. Renewable wearing gibs shall be fabricated from a durable plastic compound material having a low coefficient of friction and long wearing qualities. Gibs shall be the type requiring minimum rail lubrication.

### 2.4 PASSENGER ELEVATOR HOISTWAY ENTRANCES

#### 2.4.1 Hoistway Doors

Hoistway doors for passenger elevators shall be designed and fabricated as part of a Class B 1-1/2 Hour fire-rated door/frame assembly to meet requirements of NFPA 252 and shall bear the label of an approved testing laboratory. Doors for passenger elevators shall be hollow metal type with plain panel design not less than 1-1/4 inchesthick with 16 gauge face sheet-steel panels. Sight guards to match door finish. Each door shall be reinforced with continuous vertical members and filled with sound-deadening material. Doors shall be reinforced to accept the required operating mechanism and hardware. Doors shall have two removable door guides per panel. Seams, binding strips or screws shall not be visible from the landing. Exposed steel shall be finished with rust-inhibitive primer and baked-enamel in a color to be selected, unless otherwise specified.

#### 2.4.2 Hoistway Frames

Hoistway frames for passenger elevators shall be designed and fabricated as part of a Class B 1-1/2 Hour fire-rated door/frame assembly to meet requirements of NFPA 252 and shall bear the label of an approved testing laboratory. Frames shall be formed 14 gauge sheet-steel [with stainless steel cladding] with head and jamb in flush alignment and corners welded and ground smooth. Head and jamb section shall be bolted assembly with bolts, washer and locking nut or lock washer. Frame assembly shall be

securely fastened to the structure. Frames shall return to the wall. Exposed steel shall be finished with rust-inhibitive primer and baked-enamel in a color to be selected, unless otherwise specified.

#### 2.4.3 Symbols

Raised stainless steel symbols as required by FED-STD 795 and 36 CFR 1191 of color selected, shall be provided at each floor to indicate the floor location. Symbols shall be attached with concealed fasteners. Symbols shall be placed in a location which can be seen by passenger from the opened passenger elevator doors.

#### 2.4.4 Sills

Sills for passenger elevators shall be extruded aluminum with slip-resistant surface and machined grooves for door guides, secured to floor beams.

#### 2.4.5 Strut Angles

Strut angles for passenger elevators shall be structural steel of size not less than 3 x 3 x 3/16 inch extending from sill to beam above and anchored to building structure with structural steel fastenings and bracings of structural members with a cross section of not less than strut angles.

#### 2.4.6 Door Hangers and Housing

Each door panel shall be provided with not less than two sheave-type hangers designed for required door operation. Hanger housing and support shall be fabricated from formed Z-shaped steel angles of size not less than 3/16 inch thick bolted to strut angles.

#### 2.4.7 Door Rollers

Door rollers shall be constructed with grease-packed ball-bearings and shall be tired with a sound-reducing material. Diameter of rollers shall not be less than 3-1/4 inches for car doors and not less than 2-1/4 inches for hoistway doors. Upward thrust shall be taken by a hardened and ground ball-bearing roller assembled on an eccentric stud to provide adjustment.

#### 2.4.8 Hanger Track

Hanger track shall be of high carbon cold-drawn steel, round at top to receive door rollers, round at bottom to receive up-thrust rollers, of size engineered to accommodate load requirements.

#### 2.4.9 Covers and Guards

Hanger covers, dust covers, toe guards and fascia plate shall be fabricated from 16 gauge reinforced steel and finished with baked-enamel. Hanger covers shall extend the full door travel and shall be mounted in sections for ease of servicing door hangers. Dust covers shall be provided over top terminal landing door only and shall be secured to hanger housing and building structure. Toe guards shall be secured to sill. Fascia plates

shall be provided between each door hanger housing and sill.

## 2.5 PASSENGER ELEVATOR DOOR OPERATION

Car and hoistway doors for passenger elevators shall be operated simultaneously by an electric-power door operator. Doors shall operate smoothly in the opening direction and closing direction and be electrically or hydraulically cushioned to stop at both the full-open and full-closed position. Operators shall be high-speed heavy-duty type which will provide an average door-opening speed of 2-1/2 fps. Car and hoistway doors shall be opened and closed simultaneously in a maximum time of 4.5 seconds. When on automatic operation door-closing time shall not exceed 4.5 seconds and door-closing force shall not exceed 30 pounds. Reversal of doors when closing shall be accomplished by the "DOOR OPEN" button, car door safety edge, or interruption of the photoelectric light beams. Doors shall be arranged so that doors can be opened manually in the event of power failure.

## 2.6 PASSENGER ELEVATOR OPERATING AND SIGNAL FIXTURES

### 2.6.1 General

Elevator fixtures and panels for passenger elevators shall be constructed of 1/8 inch thick faceplates of stainless steel. Fastenings for all exposed fixtures shall be secured with tamper-proof spanner-head screws of same material and finish as fixture. Hall and car call-buttons shall be the call-register type with a low-voltage power supply not to exceed 48 volts. Pressure on a button shall illuminate button to indicate that a call in the desired direction has been registered. Car and hall fixtures shall be designed and located at the prescribed height to accommodate the handicapped in accordance with FED-STD 795 and 36 CFR 1191 for passenger elevators only. Handicapped markings shall be integral with faceplates in accordance with FED-STD 795 and 36 CFR 1191. Surface-applied markings are not acceptable. Engraving shall be black-filled except for fire-service identification which shall be red-filled. Operating and signal fixture contacts and lamps shall be completely enclosed in steel boxes finished with a baked-enamel. Boxes for hall landing devices shall be equipped for proper adjustment to wall. Lamps shall be installed in light-tight compartments. Cover-plates shall be provided with rubber gaskets when exposed to weather or harmful contaminants. Replacement bulbs shall be readily available from three sources.

### 2.6.2 Car Operating Panel

Car operating panel for passenger elevators shall be provided with the necessary raised (0.03 inch) markings for the handicapped, and shall include a series of minimum 3/4 inch diameter push-buttons numbered to correspond to the floor served and various additional switches, buttons and light jewels, including emergency stop, alarm button, "DOOR OPEN" button and communication speaker. Operating buttons shall be of manufacturer's standard design. [Operating buttons shall be vandal-resistant metal encased and embossed to permit illumination when a call is registered. Buttons shall be designed with 1/32 inch operating clearance to set on faceplate in lieu of the button mechanism. Buttons shall have maximum protrusion of 3/16 inch beyond the faceplate and shall have beveled edges

to prevent damage from side blows. Buttons and switches not required for automatic or fire-service operation shall be key-operated and mounted on front-return car operating station. Elevator number and "NO SMOKING" shall be international symbol engraved on upper portion of car. Operating panel in car shall consist of a flush-mounted panel containing the following operating devices:

- a. "DOOR OPEN" button.
- b. "DOOR CLOSE" button.
- c. Key-operated car fan/light switch.
- d. Key-operated ventilating blower switch/call light.
- e. Communication speaker phone, grille and push-to-call button.
- f. Emergency stop-switch key-operated when operated will stop the car independently of normal stopping devices. Operation of emergency stop switch shall not cause any power variance or surge that may affect the operation or condition of the control panel or its components.
- g. Emergency signal-switch connected to a 6 inch diameter signal bell outside of elevator hoistway at first floor located as shown or as directed.
- h. Key-operated inspection switch which will render normal operation inoperative for the purpose of using the hoistway access switch.
- i. Key-operated fire-service switch and light jewel.

#### 2.6.3 Auxiliary Car Operating Panel

Auxiliary car operating panel for passenger elevators shall be similar in design to main car panel, and shall include all devices necessary for automatic operation such as emergency stop switch, alarm bell, "DOOR OPEN" button.

#### 2.6.4 Hall-Call Station

Hall-call operating devices for passenger elevators at landing shall consist of an "UP" push-button at bottom landing, a "DOWN" push-button at top landing, and "UP" and "DOWN" push-buttons at all other landings. Buttons shall be manufacturer's standard design, vandal-resistant metal encased and back-lighted to permit illumination when a call is registered. Buttons shall be designed with 1/32 inch operating clearance to seat on faceplate in lieu of button mechanism. Buttons shall have maximum protrusion of 3/16 inch beyond faceplate with beveled edges to prevent damage from side blows.

##### 2.6.4.1 Commandeering Switch

Key-operated commandeering switch for passenger elevators shall be provided

at each landing and located in landing call-button cover plate. Switch shall be momentary pressure type with the key removable only in "Off" position and shall be keyed to match the independent operation switch specified for car operating devices.

#### 2.6.4.2 Fire-Service Switch

Fire-service switch for passenger elevators shall be located at the designated landing.

#### 2.6.5 Direction Lanterns

Lanterns for passenger elevators shall be in accordance with FED-STD 795 and 36 CFR 1191 and shall be provided at all floor landings and in each car entrance column. Lanterns shall be the manufacturer's standard, vandal-resistant design. Lanterns shall signal the approach of a stopping car when car is a predetermined distance from landing.

#### 2.6.6 In-Car Car-Position Indicator

Indicator numerals and directional arrows for passenger elevators shall be flush-mounted faceplate with black-filled engraved numerals not less than 1 inch high and 3/8 inch diameter vandal-resistant light jewels directly beneath each number. As car travels through hoistway the car position shall be indicated by illumination of light jewel corresponding to landing at which the car is stopped or passing. Necessary light baffles shall be provided. Floor numerals and letters shall illuminate white. A position indicator of the digital-readout or dot-matrix type (minimum 2 inch high indication) shall be provided in car transom panel. Number corresponding to car position shall remain illuminated when motor drive is shut down. Illumination shall be shrouded in an approved manner to protect against glare from car lighting.

#### 2.6.7 Audible Signals

An automatic voice announcement of the floor landing at which the car stops shall be provided inside each car. In addition, an audible signal shall be provided at each floor landing and shall sound coincident with the landing lantern illumination indicator. An audible signal shall be provided at each floor landing and in each car and shall sound coincident with the lantern illumination indicators. The audible signal shall be no less than 20 decibels with a frequency no higher than 1500 Hz. The audible signal shall sound once for UP direction and twice for DOWN direction.

#### 2.6.8 Combination Hall-Position Indicator and Directional Arrows

Combination hall-position indicator and directional arrows for passenger elevators shall be provided at first floor landing directly above entrance frame. A digital-readout position and direction indicator (minimum 2 inch high indication) for passenger elevators shall be provided over first floor entrance. As elevator travels in hoistway, elevator position shall be indicated by illumination in alpha-numeric characters corresponding to the landing where elevator is stopped or passing. Number corresponding to position of car shall remain illuminated when motor is shut down. An

audible signal shall sound in elevator car to indicate that the elevator is stopping or passing a floor served by elevator. Fixture design and operation shall be similar in design to that specified for Car Position Indicator.

## 2.7 PASSENGER CAR OPERATION (SINGLE-CAR SELECTIVE/COLLECTIVE)

Car shall be arranged so that by pressing one or more car buttons or landing buttons the car will start automatically and stop at first floor for which the button has been pressed which corresponds to the direction in which the car is traveling. Car shall stop in the order in which the floors are reached by the car and at all floors for which calls have been registered, regardless of the sequence in which buttons have been pressed, provided button for a given floor has been pressed sufficiently in advance of car's arrival at that floor to permit the stop to be made. If car buttons have not been pressed, and car responds to several DOWN calls, car shall travel to highest DOWN call first and then reverse to collect UP calls. UP calls shall be collected in the same way when car starts DOWN in response to UP calls by first stopping for the lowest UP call registered. When a car has stopped in response to the pressing of a landing button and a car button is pressed corresponding to the direction in which the car has been traveling, within a predetermined interval of time after the stop, the car shall continue in that direction regardless of other landing calls registered. While car is in motion landing calls in the opposite direction of car movement shall not affect the operation of car but calls shall remain registered. After last car call has been answered in the direction the car is traveling, car shall automatically reverse and answer registered landing calls and all car calls in the order the landings are reached. When all calls have been answered, the car shall stop at the last floor served and shall have the doors closed.

## 2.8 AUTOMATIC ELEVATOR OPERATION

### 2.8.1 General

The operating device shall consist of a series of push-buttons in the car numbered to correspond to various landings, "UP" and "DOWN" buttons at intermediate landings and a single button at terminal landing. To meet the elevator operation requirements specified in this section all buttons shall be connected electrically to the control system which governs the floor selection, car selection, direction of travel and governs the acceleration and retardation.

### 2.8.2 Operation

Car calls shall be registered within the car by pressing the button corresponding to the designated floors. Hall calls shall be registered by pressing buttons in the corridor push-button fixture. Once the demand for elevator service has been established and the car has received a start signal the car operation shall be as follows.

#### 2.8.2.1 Door Closing

Doors shall close automatically. When doors are fully closed and the

interlock circuit established, the car shall start to move in the direction established by control system. Car shall accelerate and decelerate automatically and stop at first floor for which a car button has been registered or at first floor for a corridor demand which has been assigned to car. Car shall stop at all floors for which car calls are registered in the order in which the floors are reached and shall stop for any corridor demands assigned to the cars in the order in which the floors are reached.

#### 2.8.2.2 Door Opening

Doors shall open automatically as car reaches the landing. After a predetermined time the doors shall close and the car shall proceed to answer the remaining car or assigned corridor calls. A protective device such as a safety edge and light beam device shall be provided on car door and when activated will prevent closing of doors. Cars shall become available for assignment at whatever floor the last car demand has been satisfied in the direction in which the car is traveling.

#### 2.8.2.3 Car Dispatch

When car does not receive a demand dispatch at dispatching floor for an adjustable time period up to 10 minutes set initially at 5 minutes, the motor drive unit shall be switched-off. If the car's switched-off motor drive unit receives a demand dispatch the motor drive unit shall automatically restart.

#### 2.8.2.4 Door Dwell-Time

Door open dwell-times shall be adjustable so that the open time for a car call is shorter than the open time for corridor calls and second passengers. If a longer time is needed for passenger entry, doors can be prevented from closing or reversing by the light beam door control, the protective leading edge on car door, or by pressing "DOOR OPEN" button in car. Door dwell-times shall comply with FED-STD 795 and 36 CFR 1191.

#### 2.8.3 Anti-Nuisance

Passenger elevators shall be provided with a system which will cancel all car calls in the event that between 3 to 5 times the number of car calls are registered as there are passengers in car, allowing 150 pounds per passenger.

#### 2.8.4 Door Operation

Double-door operation are not acceptable for passenger elevators. If an UP traveling car has a passenger for an intermediate floor and a DOWN call is registered at that floor with no-calls above car, the car shall travel to floor, open the door and let passenger out, then light the DOWN direction arrow in hall lantern and accept the waiting passenger who registered the DOWN call. Doors shall not perform the open-close cycle before elevator proceeds to next call.

#### 2.8.5 Automatic Power Shutdown

Automatic power shutdown of the elevators will be initiated by a waterflow switch supervising sprinklers located in the elevator machine room or in the elevator hoistway. Provide heat detectors which are fixed-temperature-rate-of-rise type, rated at 135 to 140 degrees F adjacent to each sprinkler head in the hoistway(s) and in the machine room. Heat detectors shall be connected to the elevator control system which shall cause the following to the affected elevators), upon activation of the heat detector.

- a. Elevators which are in motion will proceed to the nearest available landing away from fire floor, and shall cause power-operated doors to open and remain open until manually reset. The fire floor is considered the floor where the actuated heat detector is located.
- b. Elevators which are standing at a landing with open doors will remain open at the floor. If power-operated doors are closed, the elevator system will cause doors to open.

## 2.9 SENSOR AND CONTROL WIRE SURGE PROTECTION

Digital and analog inputs shall be protected against surges induced on control and sensor wiring. Digital and analog outputs shall be protected as shown against surges induced on control and sensor wiring installed outdoors. Fuses shall not be used for surge protection. The inputs and outputs shall be tested in both normal mode and common mode using the following waveforms:

- a. A 10 microsecond rise time by 1000 microsecond pulse width waveform with a peak voltage of 1500 volts and a peak current of 60 amperes.
- b. An eight microsecond rise time by 20 microsecond pulse width waveform with a peak voltage of 1000 volts and a peak current of 500 amperes.

## 2.10 COMMUNICATIONS LINKS SURGE PROTECTION

Communications equipment shall be protected against surges induced on any communications link. Cables and conductors, except fiber optics, which serve as communications links from Motor Control Room (MCR) to field equipment, and between field equipments shall have surge protection circuits installed at each end. Protection shall be furnished at equipment and additional triple electrode gas surge protectors rated for the application on each wireline circuit shall be installed within 3 feet of the building cable entrance. Fuses shall not be used for surge protection. The inputs and outputs shall be tested in both normal mode and common mode using the following two waveforms:

- a. A 10 microsecond rise time by 1000 microsecond pulse width waveform with a peak voltage of 1500 volts and a peak current of 60 amperes.

- b. An eight microsecond rise time by 20 microsecond pulse width waveform with a peak voltage of 1000 volts and a peak current of 500 amperes.

## 2.11 COMMUNICATIONS LINKS OVER VOLTAGE PROTECTION

Communications equipment such as MODEMs, line drivers, and repeaters shall be protected against overvoltage on any communications link conductors. Cables and conductors, which serve as communications links, except fiber optics, shall have overvoltage protection for voltages up to 480 Vac rms, 60 Hz installed. Instrument fuses or fusible resistors are required for this application.

## 2.12 FIREFIGHTERS SERVICE

Firefighter service shall be in accordance with ASME A17.1 for automatic elevators. Elevator lobby and machine room smoke detectors shall be photoelectric spot-type smoke detectors. Smoke detectors shall be powered from the building fire alarm control panel. Elevator lobby and machine room smoke detectors shall be in accordance with Section 13851 FIRE DETECTION AND ALARM SYSTEM, ADDRESSABLE.

## 2.13 ELEVATOR POWER UNIT

### 2.13.1 Pumping and Control Mechanism

Hydraulic fluid shall be provided in the reservoir, pump and control valve.

Hydraulic fluid shall have a minimum fire point of 375 degrees F as established by ASTM D 92. If oil temperature drops below pre-set minimum, elevator shall be dispatched automatically to lowest terminal floor at which point the pump will bypass oil in system without car motion until pre-set temperature is reached. Normal response to passenger demand shall not be affected by this control. Resistance type heating elements do not meet the intent of this specification.

#### 2.13.1.1 Oil Temperature Device

An oil temperature device shall be provided that will maintain oil temperature between 70 degrees and 100 degrees F regardless of ambient temperatures.

#### 2.13.1.2 Pump

Pump shall be a rotary-positive displacement type for oil-hydraulic elevator service designed for steady discharge with minimum pulsation to give smooth and quiet operation, with an output which will not vary more than 10 percent between no-load and full-load on the elevator. Operating pressure shall not exceed 400 psi.

#### 2.13.1.3 Piping

Piping shall be ASTM A 53/A 53M Grade E or S, ASTM A 106 Grade B, or grooved piping system of minimum schedule 40 seamless steel conforming to ASME A17.1 and ASME B16.11. Pipes shall conform to the cleanliness

requirements of ASME B31.1.

#### 2.13.1.4 Motor

Motor shall be especially designed for oil-hydraulic elevator service and shall be of standard manufacture duty rating and provided with specified speeds and loads.

#### 2.13.1.5 Oil-Control Unit

Oil-control unit shall contain the following valve assemblies:

- a. Automatic shut-off valve shall be provided in the oil-supply line as close to the cylinder inlet as possible. When there is a 10 percent drop in NO-LOAD operating pressure, the automatic shut-off valve shall be activated. When activated, the device shall immediately stop the descent of elevator and hold the elevator until it is lowered by use of the maximum lowering feature of the valve. Manual lowering feature of automatic shut-off valve shall be arranged to limit the maximum descending speed of elevator to 15 feet per minute. Exposed adjustments of automatic shut-off shall have the means of adjustment sealed after being set to the correct position.
- b. Relief-valve for hydraulic shall be externally adjustable and shall bypass the total oil flow without increasing back pressure by more than 56 percent above working pressure.
- c. Safety check-valve shall close quietly without permitting any perceptible reverse flow and shall be designed to support the elevator on a positively locked column of oil when car is at rest.
- d. Up-start and stop valve shall be externally adjustable and shall bypass oil flow during the start-and-stop of motor-pump assembly. Valve shall close slowly, gradually diverting oil to the jack unit to insure smooth up-start and up-step.
- e. Lowering and leveling valve shall be externally adjustable for drop-away speed, lowering speed, leveling speed and stopping speed to insure smooth down-starts and stops. Leveling valve shall be designed to level the car to floor in the direction the car is traveling when slowdown is initiated.
- f. Manual lowering valve shall be capable of lowering the elevator car in event of power failure. Manual-lowering valve shall be arranged to limit the maximum descending speed under manual operation to 15 fpm.
- g. A service check-valve shall be installed in oil supply line between power unit and jack.

#### 2.13.1.6 Storage Tank

Storage tank shall be single-wall construction of steel with a steel cover.

Manufacturer's recommendation for the type of oil to be used shall be included in written instructions for the care, adjustment and maintenance of equipment.

#### 2.13.1.7 Controller

Electric controller shall be of the microprocessor based logic type with battery backup provided with reduced voltage starting. Components required for proper elevator performance shall be neatly mounted and wired and completely enclosed in a cabinet with a mechanically-latched door. Control cabinet shall be designed for mounting on power unit, wall or floor stand. Electric control apparatus shall be completely isolated from oil reservoir.

A feature shall be incorporated in electrical control circuit which will cause elevator car to descent automatically to the lowest terminal landing, if the system runs low on oil during ascending of the car. If power-operated doors are used, the car and hoistway doors shall automatically open when car reaches landing to allow passengers to exit. Parked car shall have doors in closed position and all control buttons shall be made inoperative.

#### 2.13.2 Sound Reduction

Sound-insulating panels shall isolate airborne noise from motor pump assembly. Openings shall be provided to adequately ventilate the power unit motor. A minimum of two sound-isolating couplings shall be installed in oil line in machine room between pump and jack. Couplings shall be designed and manufactured to be blowout proof. Oil-hydraulic silencer shall be installed in oil line near power unit and shall contain pulsation absorbing material surrounded by a blowout-proof housing. Power unit assembly shall be mounted on vibration pads to isolate the unit from building structure.

#### 2.14 LEVELING DEVICE

Elevators shall be equipped with a 2-way leveling device to automatically bring the car to floor landings. Car shall automatically re-level at each landing to correct the overtravel and undertravel, and maintain the level regardless of load on car. Electric stopping system shall be arranged so that the car will stop level with the floor before brake is set. Stopping accuracy shall not exceed a plus or minus 1/4 inch.

#### 2.15 JACK UNIT

A telescopic, holeless jack system shall be designed and constructed of sufficient size to lift the gross load to the height specified and shall be free from oil leakage. Brittle material such as grey cast iron shall not be used in jack construction. Telescoping plunger shall be fabricated of heavy seamless steel tubing accurately turned and polished

- a. Stop-ring welded or screwed to the plunger to positively prevent plunger from leaving the cylinder.
- b. Internal guide bearing.

- c. Packing or seal.
- d. Drip ring around cylinder top.
- e. Outer cylinder made of steel tubing.
- f. Air bleeder.
- g. Brackets welded to jack cylinder for supporting the elevator on pit channels.
- h. Scavenger pump with copper tubing connected to the tank.

#### 2.16 ELEVATOR SUPPORTS

Structural steel beams, inserts, brackets, bolts and fastening devices shall be provided for proper installation of elevator equipment. Wood plugs are not acceptable.

#### 2.17 BUFFERS

Buffers shall be of design suitable for depth of pit. Type of buffer used shall be tested and approved for compliance with elevator service requirements before installation. Pipe struts and steadiers shall be provided as required for pit conditions. A metal plate with information concerning stroke and load-rating shall be permanently fastened to each buffer. Pit-mounted buffers shall have an adequate stroke designed to bring the fully-loaded car and counterweight to rest from governor tripping speed at an average rate of retardation not exceeding gravity. Moving portion of buffer shall be designed to be accelerated by the car without noticeable peak retardation. Spring buffers shall be in accordance with ASME A17.1.

#### 2.18 LUBRICATION POINTS

Every part subject to movement friction shall be provided with provisions for oil or grease lubrication. All points of lubrication shall be readily accessible.

#### 2.19 SEISMIC REQUIREMENTS

Seismic protection shall be provided in conformance with TI 809-04 for general guidance and computation of forces (1.0 G horizontal and 1.0 G vertical minimum), ASME A17.1, Rule XXIV, and ICBO Bldg Code as shown on the drawings. The Contractor shall hire a registered engineer to submit the stamped calculations and drawings.

### PART 3 EXECUTION

#### 3.1 INSTALLATION

Elevators and equipment shall be installed in accordance with ASME A17.1

and manufacturer's recommendation. Guide rails shall be set plumb and parallel and attached to guide rail brackets secured to building structure as per manufacturer's recommendations.[\_\_\_\_\_] feet [\_\_\_\_\_] inches. Steel shim plates shall be used for aligning equipment. Guide rail sections shall be joined together in accordance with ASME A17.1. Guide rails shall be thoroughly cleaned and made smooth before elevator is put into operation. During installation all stainless steel shall be protected.

### 3.2 FIELD WELDING

When structural or load-bearing members are to be field welded, welding and qualification of welders shall be as specified in Section 05055WELDING, STRUCTURAL.

### 3.3 ELEVATOR WIRING

Wiring shall be provided for electrically-operated items of elevator equipment to comply with requirements of NFPA 70 and Section 16415 ELECTRICAL WORK, INTERIOR. For control and signal circuits wire shall be minimum No. 18 AWG. For power and lighting circuits wire shall be minimum No. 12 AWG. Work light fixtures equipped with 150 watt incandescent lamps and ground duplex receptacles shall be provided at top and bottom of car. Work light fixtures and traveling cable junction boxes shall be located to provide illumination at junction boxes. Wiring shall terminate in junction boxes. Wires shall be identified and shall match symbols shown on wiring diagrams. Control and signal wires shall be brought to accessible numbered terminal blocks on the controller. Intra-panel wiring shall be flame-resistant type.

#### 3.3.1 Traveling Cables

Cables shall terminate at numbered terminal blocks in car and machine room. Traveling cable shall be provided with a separate shielded circuit for communication system and hang to obtain proper size of loop. Traveling cable shall be provided with 10 percent spare conductors for each car.

### 3.4 PAINTING AND PIPE COLOR CODE MARKING

Except for factory-finished items and corrosion-resistant items, machined surfaces shall be painted as specified in Section 09900 PAINTING, GENERAL.

### 3.5 TESTING

Testing shall be in accordance with requirements of ASME A17.1 and ASME A17.2.2; and as specified below. The Contractor shall conduct a complete test of the system. After the system has passed all tests, the Contractor shall notify the Contracting Officer in writing, seven days prior to the time of performing the acceptance test, that the system is complete and is ready for final acceptance testing. The Contractor after receiving written approval from the Contracting Officer will conduct a complete acceptance test of the system. The Contractor shall provide the services of an elevator inspector, employed by an independent testing company to inspect the elevators, witness the final testing and certify the elevators. The inspector shall meet all qualification requirements of ASME QEI-1 and shall

be certified in accordance with ASME QEI-1. The Contractor shall provide an elevator certificate signed by the inspector for the elevator. The certificate shall be provided to the Contracting Officer within 30 day after the completion of all testing.

#### 3.5.1 Testing Period

The elevator shall be tested with the specified rated-load in car continuously for a period of 35 percent of the duty time. During the test run the car shall be stopped at all floors in both directions of travel for a standing period of 10 seconds per floor. A manual test of the final limits (UP and DOWN overtravel) shall also be performed.

#### 3.5.2 Speed Load Testing

The actual speed of elevator car in both directions of travel shall be determined with the rated-load and with no-load in the elevator car. Actual measured speed of car with the rated-load in the UP direction shall be within 5 percent of rated speed. The maximum difference in actual measured speeds obtained under the various conditions outlined shall not exceed 10 percent of the total difference between the UP and DOWN speeds.

#### 3.5.3 Car Leveling Testing

Elevator car-leveling devices shall be tested for accuracy of landing at all floors with no-load in car, with symmetrical load in car and with the rated-load in car in both directions of travel.

#### 3.5.4 Temperature Rise Testing

Temperature rise of hydraulic pump motor, motor drive, exciter and booster shall be conducted during the full-load test run for minimum one hour. Under these conditions, temperature rise of equipment shall not exceed the requirements established in NEMA MG 1 Chapter 12. Test shall be started when all parts of equipment are within the temperature required by NEMA at time of starting tests.

#### 3.5.5 Insulation-Resistance Testing

Insulation-resistance testing shall be performed to ensure that the complete elevator wiring systems will be free from short circuits and grounds. Electrical conductors shall have an insulation-resistance of not less than 1 megohm between each conductor and ground, and not less than 1 megohm between each conductor and all other conductors. Prior to testing, provisions shall be made to prevent damage to electronic devices.

#### 3.6 FRAMED INSTRUCTIONS

Two sets of instructions shall be typed and framed under glass or in laminated plastic, and posted side-by-side in the elevator room where directed before acceptance of elevator systems. First set of instructions shall include wiring and control diagrams showing the complete layout of elevator system. Second set of instructions shall include the condensed operating instructions describing preventive maintenance procedures, the

methods for checking the elevator system for normal safe operation, and the procedures for safely starting and stopping the elevator system.

### 3.7 OPERATOR TRAINING

Contractor shall conduct a formal training course for operating Government personnel which shall include care, lubrication, adjustment and maintenance of elevator equipment. Training period shall consist of a total of 24 hours of normal working time and shall start after the system is functionally completed but prior to final acceptance tests. Field instructions shall cover all of the items contained in the operating and maintenance instructions, including demonstrations of routine maintenance operations. Contracting Officer shall be notified at least 14 days prior to date of starting the training course.

-- End of Section --

## SECTION 15995

COMMISSIONING OF HVAC SYSTEMS  
01/93

## PART 1 GENERAL

## 1.1 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

## SD-03 Product Data

Commissioning Team; G, RE

List of team members who will represent the Contractor in the pre-commissioning checks and functional performance testing, at least 2 weeks prior to the start of pre-commissioning checks. Proposed revision to the list, prior to the start of the impacted work.

Test Procedures; G, RE

Detailed procedures for pre-commissioning checks and functional performance tests, at least 4 weeks prior to the start of pre-commissioning checks.

Test Schedule; G, RE

Schedule for pre-commissioning checks and functional performance tests, at least 2 weeks prior to the start of pre-commissioning checks.

## SD-06 Test Reports

Test Reports; G, RE

Completed pre-commissioning checklists and functional performance test checklists organized by system and by subsystem and submitted as one package. The results of failed tests shall be included along with a description of the corrective action taken.

## 1.2 SEQUENCING AND SCHEDULING

The work described in this Section shall begin only after all work required in related Sections, including, but not limited to, Section 15951 DIRECT

DIGITAL CONTROL FOR HVAC and Section 15990 TESTING, ADJUSTING AND BALANCING OF HVAC SYSTEMS, has been successfully completed, and all test and inspection reports and operation and maintenance manuals required in these Sections have been submitted and approved. Seismic details shall be in accordance with Sections 13080 SEISMIC PROTECTION FOR MISCELLANEOUS EQUIPMENT and 15070 SEISMIC PROTECTION FOR MECHANICAL EQUIPMENT.

PART 2 PRODUCTS (Not Applicable)

PART 3 EXECUTION

3.1 COMMISSIONING TEAM AND CHECKLISTS

The Contractor shall designate team members to participate in the pre-commissioning checks and the functional performance testing specified herein. In addition, the Government will be represented by a representative of the Contracting Officer, the Design Agent's Representative, and the Using Agency. The team members shall be as follows:

Designation	Function
Q	Contractor's Chief Quality Control Representative
M	Contractor's Mechanical Representative
E	Contractor's Electrical Representative
T	Contractor's Testing, Adjusting, and Balancing Representative
C	Contractor's Controls Representative
D	Design Agent's Representative
O	Contracting Officer's Representative
U	Using Agency's Representative

Each checklist shown in appendices A and B shall be completed by the commissioning team. Acceptance by each commissioning team member of each pre-commissioning checklist item shall be indicated by initials and date unless an "X" is shown indicating that participation by that individual is not required. Acceptance by each commissioning team member of each functional performance test checklist shall be indicated by signature and date.

3.2 TESTS

The pre-commissioning checks and functional performance tests shall be performed in a manner which essentially duplicates the checking, testing, and inspection methods established in the related Sections. Where checking, testing, and inspection methods are not specified in other Sections, methods shall be established which will provide the information required. Testing and verification required by this section shall be performed during the Commissioning phase. Requirements in related Sections are independent from the requirements of this Section and shall not be used to satisfy any of the requirements specified in this Section. The Contractor shall provide all materials, services, and labor required to perform the pre-commissioning checks and functional performance tests. A pre-commissioning check or functional performance test shall be aborted if any system deficiency prevents the successful completion of the test or if

any participating non-Government commissioning team member of which participation is specified is not present for the test. The Contractor shall reimburse the Government for all costs associated with effort lost due to tests that are aborted. These costs shall include salary, travel costs and per diem (where applicable) for Government commissioning team members.

#### 3.2.1 Pre-Commissioning Checks

Pre-commissioning checks shall be performed for the items indicated on the checklists in Appendix A. Deficiencies discovered during these checks shall be corrected and retested in accordance with the applicable contract requirements.

#### 3.2.2 Functional Performance Tests

Functional performance tests shall be performed for the items indicated on the checklists in Appendix B. Functional performance tests shall begin only after all pre-commissioning checks have been successfully completed. Tests shall prove all modes of the sequences of operation, and shall verify all other relevant contract requirements. Tests shall begin with equipment or components and shall progress through subsystems to complete systems. Upon failure of any functional performance test checklist item, the Contractor shall correct all deficiencies in accordance with the applicable contract requirements. The checklist shall then be repeated until it has been completed with no errors.

## APPENDIX A

## PRE-COMMISSIONING CHECKLISTS

## Pre-commissioning checklist - Piping

For HWS, HWR, CHWS, CHWR, GCWS, GCWR Piping System

Checklist Item	Q	M	E	T	C	D	O	U
Installation								
a. Piping complete.	___	___	X	___	X	___	___	___
b. As-built shop drawings submitted.	___	___	X	___	X	___	___	___
c. Piping flushed and cleaned.	___	___	X	___	X	___	___	___
d. Strainers cleaned.	___	___	X	___	X	___	___	___
e. Valves installed as required.	___	___	X	___	X	___	___	___
f. Piping insulated as required.	___	___	X	___	X	___	___	___
g. Thermometers and gauges installed as required.	___	___	X	___	X	___	___	___
h. Verify operation of valves.	___	___	X	___	___	___	___	___
i. Air vents installed as specified.	___	___	X	X	X	___	___	___
j. Flexible connectors installed as specified	___	___	X	X	X	___	___	___
k. Verify that piping has been labeled and valves identified as specified.	___	___	X	___	___	___	___	___
Testing, Adjusting, and Balancing (TAB)								
a. Hydrostatic test complete.	___	___	X	___	X	___	___	___
b. TAB operation complete.	___	___	X	___	___	___	___	___

## Pre-commissioning Checklist - Ductwork

For Air Handler: AHU - 1, 2, 3, 4

Checklist Item	Q	M	E	T	C	D	O	U
Installation								
a. Ductwork complete.	___	___	X	___	X	___	___	___
b. As-built shop drawings submitted.	___	___	X	___	X	___	___	___
c. Ductwork leak test complete.	___	___	X	___	X	___	___	___
NOTE: The first bracketed item d will be used for Army projects, the second for Air Force projects.								
d. Fire dampers, smoke dampers, and access doors installed as required with installation of each verified by the specified team members initialing each location on a copy of the as-built drawings.	___	___	X	___	X	___	___	___
e. Ductwork insulated as required.	___	___	X	___	X	___	___	___
f. Thermometers and gauges installed as required.	___	___	___	___	___	___	___	___
g. Verify open/closed status of dampers.	___	___	X	___	X	___	___	___
h. Verify smoke dampers operation.	___	___	X	___	___	___	___	___
i. Flexible connectors installed as specified	___	___	X	___	X	___	___	___
Testing, Adjusting, and Balancing (TAB)								
a. TAB operation complete.	___	___	X	___	X	___	___	___



## Pre-commissioning Checklist - Variable Volume Air Handling Unit

For Air Handling Unit: AHU - 1, 2, 3, 4

Checklist Item	Q	M	E	T	C	D	O	U
Installation								
a. Vibration isolation devices installed.	___	___	X	X	X	___	___	___
b. Inspection and access doors are operable and sealed.	___	___	X	___	X	___	___	___
c. Casing undamaged.	___	___	X	X	X	___	___	___
d. Insulation undamaged.	___	___	X	X	X	___	___	___
e. Condensate drainage is unobstructed. (Visually verify drainage by pouring a cup of water into drain pan.)	___	___	X	X	X	___	___	___
f. Fan belt adjusted.	___	___	X	___	X	___	___	___
g. Manufacturer's required maintenance clearance provided.	___	___	X	X	X	___	___	___
Electrical								
a. Power available to unit disconnect.	___	___	___	X	X	___	___	___
b. Power available to unit control panel.	___	___	___	X	___	___	___	___
c. Proper motor rotation verified.	___	___	___	___	X	___	___	___
d. Verify that power disconnect is located within sight of the unit it controls.	___	___	___	X	___	___	___	___
e. Power available to electric heating coil.	___	___	___	X	X	___	___	___
Coils								
a. Chilled water piping properly connected.	___	___	X	X	X	___	___	___
a. Refrigerant piping properly connected.	___	___	X	X	X	___	___	___
b. Chilled water piping pressure tested.	___	___	X	X	X	___	___	___
b. Refrigerant piping pressure tested.	___	___	X	X	X	___	___	___
c. Hot water piping properly connected.	___	___	X	X	X	___	___	___
c. Condensate piping properly connected.	___	___	X	X	X	___	___	___

## Pre-commissioning Checklist - Variable Volume Air Handling Unit

For Air Handling Unit: AHU - 1, 2, 3, 4

Checklist Item	Q	M	E	T	C	D	O	U
d. Hot water piping pressure tested.	___	___	X	X	X	___	___	___
d. Condensate piping pressure tested.	___	___	X	X	X	___	___	___
e. Air vents installed on water coils with shutoff valves as specified.	___	___	X	X	X	___	___	___
f. Any damage to coil fins has been repaired.	___	___	X	___	X	___	___	___

## Controls

a. Control valves/actuators properly installed.	___	___	X	___	___	___	___	___
b. Control valves/actuators operable.	___	___	X	___	___	___	___	___
c. Dampers/actuators properly installed.	___	___	X	___	___	___	___	___
d. Dampers/actuators operable.	___	___	X	___	___	___	___	___
e. Verify proper location, installation and calibration of duct static pressure sensor.	___	___	X	___	___	___	___	___
f. Fan air volume controller operable.	___	___	X	___	___	___	___	___
g. Air handler controls system operational.	___	___	X	___	___	___	___	___

## Testing, Adjusting, and Balancing (TAB)

a. Construction filters removed and replaced.	___	___	X	___	___	___	___	___
b. TAB report submitted.	___	___	X	___	X	___	___	___
c. TAB results within +10%/-0% of cfm shown on drawings	___	___	___	___	___	___	___	___
d. TAB results for outside air intake within +10%/-0% of both the minimum and maximum cfm shown on drawings.	___	___	X	___	X	___	___	___

## Pre-commissioning Checklist - VAV Terminal

For VAV Terminal: [\_\_\_\_\_]

Checklist Item	Q	M	E	T	C	D	O	U
Installation								
a. VAV terminal in place.	___	___	X	X	X	___	___	___
b. VAV terminal ducted.	___	___	X	X	X	___	___	___
c. VAV terminal connected to controls.	___	___	X	X	___	___	___	___
[d. Reheat coil connected to hot water pipe.	___	___	X	___	X	___	___	___]
[e. Electric reheat coil connected to local disconnect.	___	___	___	___	X	___	___	___]
f. Manufacturer's required maintenance clearance provided.	___	___	X	X	X	___	___	___
Controls								
a. Cooling only VAV terminal controls set.	___	___	X	X	___	___	___	___
b. Cooling only VAV controls verified.	___	___	X	X	___	___	___	___
c. Reheat VAV terminal controls set.	___	___	X	X	___	___	___	___
d. Reheat terminal/coil controls verified.	___	___	X	X	___	___	___	___
Testing, Adjusting, and Balancing (TAB)								
a. Verify terminal maximum air flow set.	___	___	X	___	___	___	___	___
b. Verify terminal minimum air flow set.	___	___	X	___	___	___	___	___
c. TAB operation complete.	___	___	X	___	X	___	___	___

## Pre-commissioning Checklist - Pumps

For Pump: All Pumps Except Domestic Hot Water Circulators

Checklist Item	Q	M	E	T	C	D	O	U
Installation								
a. Pumps grouted in place.	___	___	X	X	X	___	___	___
b. Pump vibration isolation devices functional.	___	___	X	X	X	___	___	___
c. Pump/motor coupling alignment verified.	___	___	X	X	X	___	___	___
d. Piping system installed.	___	___	X	X	X	___	___	___
e. Piping system pressure tested.	___	___	X	X	X	___	___	___
f. Pump not leaking.	___	___	X	X	X	___	___	___
g. Field assembled couplings aligned to meet manufacturer's prescribed tolerances.	___	___	X	X	X	___	___	___
Electrical								
a. Power available to pump disconnect.	___	___	___	X	X	___	___	___
b. Pump rotation verified.	___	___	___	X	X	___	___	___
c. Control system interlocks functional.	___	___	___	X	___	___	___	___
d. Verify that power disconnect is located within sight of the unit it controls.	___	___	___	X	___	___	___	___
Testing, Adjusting, and Balancing (TAB)								
a. Pressure/temperature gauges installed.	___	___	X	___	X	___	___	___
b. Piping system cleaned.	___	___	X	X	X	___	___	___
c. Chemical water treatment complete.	___	___	X	X	X	___	___	___
d. Water balance complete.	___	___	X	___	X	___	___	___
e. Water balance with design maximum flow.	___	___	X	___	X	___	___	___
f. TAB Report submitted.	___	___	X	___	X	___	___	___

## Pre-commissioning Checklist - Packaged Air Cooled Chiller

For Chiller: CH-1 &amp; CH - 2

Checklist Item	Q	M	E	T	C	D	O	U
Installation								
a. Chiller properly piped.	___	___	X	___	___	___	___	___
b. Chilled water pipe leak tested.	___	___	X	X	X	___	___	___
c. Verify that refrigerant used complies with specified requirements.	___	___	X	X	X	___	___	___
d. Any damage to coil fins has been repaired.	___	___	X	___	X	___	___	___
e. Manufacturer's required maintenance clearance provided.	___	___	X	X	X	___	___	___
Electrical								
a. Power available to unit disconnect.	___	___	___	X	___	___	___	___
b. Power available to unit control panel.	___	___	___	X	___	___	___	___
c. Separate power is supplied to electric heating tape.	___	___	___	X	___	___	___	___
d. Verify that power disconnect is located within sight of the unit it controls.	___	___	___	X	___	___	___	___
Controls								
a. Factory startup and checkout complete.	___	___	X	X	___	___	___	___
b. Chiller safety/protection devices tested.	___	___	X	X	___	___	___	___
c. Chilled water flow switch installed.	___	___	X	X	___	___	___	___
d. Chilled water flow switch tested.	___	___	X	X	___	___	___	___
e. Chilled water pump interlock installed.	___	___	X	X	X	___	___	___
f. Chilled water pump interlock tested.	___	___	___	X	___	___	___	___

## Pre-commissioning Checklist - Centrifugal Chiller

For Chiller: [\_\_\_\_\_]

Checklist Item	Q	M	E	T	C	D	O	U
Installation								
a. Chilled water connections properly piped.	___	___	X	___	___	___	___	___
b. Condenser water connections properly piped	___	___	X	___	___	___	___	___
c. Chilled water pipe leak tested.	___	___	X	X	X	___	___	___
d. Condenser water pipe leak tested.	___	___	X	X	X	___	___	___
e. High efficiency purge unit installed and operating as specified.	___	___	X	X	X	___	___	___
f. Refrigerant leak detector installed.	___	___	___	___	___	___	___	___
g. Oxygen sensor installed and tested.	___	___	___	___	___	___	___	___
h. Mechanical room ventilation installed as specified.	___	___	___	___	___	___	___	___
i. Manufacturer's required maintenance clearance provided.	___	___	X	X	___	___	___	___
j. Field assembled couplings aligned to meet manufacturer's prescribed tolerances.	___	___	X	X	X	___	___	___
Electrical								
a. Power available to unit starter.	___	___	___	X	___	___	___	___
b. Power available to unit control panel.	___	___	___	X	___	___	___	___
c. Verify that power disconnect is located within sight of the unit it controls.	___	___	___	X	___	___	___	___
Controls								
a. Factory startup and checkout complete.	___	___	X	X	___	___	___	___
b. Chiller safety/protection devices tested.	___	___	___	X	___	___	___	___
c. Chilled water flow switch installed.	___	___	X	X	___	___	___	___
d. Chilled water flow switch tested.	___	___	X	X	___	___	___	___
e. Chilled water pump interlock installed.	___	___	___	X	___	___	___	___

## Pre-commissioning Checklist - Centrifugal Chiller

For Chiller: [\_\_\_\_\_]

Checklist Item	Q	M	E	T	C	D	O	U
f. Chilled water pump interlock tested.	___	___	___	X	___	___	___	___
g. Condenser water flow switch installed.	___	___	X	___	___	___	___	___
h. Condenser water flow switch tested.	___	___	___	X	___	___	___	___
i. Condenser water pump interlock installed.	___	___	___	X	___	___	___	___
j. Condenser water pump interlock tested.	___	___	___	X	___	___	___	___

## Pre-commissioning Checklist - Hot Water Boiler

For Boiler: B - 1, B - 2, B - 3, B - 4

Checklist Item	Q	M	E	T	C	D	O	U
Installation								
a. Boiler flue installed.	___	___	X	___	___	___	___	___
b. Boiler hot water piping installed.	___	___	X	___	___	___	___	___
c. Boiler hot water piping tested.	___	___	X	X	___	___	___	___
d. Boiler makeup water piping installed.	___	___	X	___	___	___	___	___
e. Boiler gas piping installed.	___	___	X	X	X	___	___	___
f. Boiler gas piping tested.	___	___	X	X	X	___	___	___
g. Manufacturer's required maintenance clearance provided.	___	___	X	___	___	___	___	___
Startup								
a. Boiler system cleaned and filled with treated water.	___	___	X	___	___	___	___	___
b. Boiler safety/protection devices, including high temperature burner shut-off, low water cutoff, flame failure, pre and post purge, have been tested.	___	___	___	X	___	___	___	___
c. Verify that PRV rating conforms to boiler rating.	___	___	___	X	___	___	___	___
d. Boiler water treatment system functional.	___	___	X	X	___	___	___	___
e. Boiler startup and checkout complete.	___	___	X	X	___	___	___	___
f. Combustion efficiency demonstrated.	___	___	X	___	X	___	___	___
Electrical								
a. Verify that power disconnect is located within sight of the unit served.	___	___	___	X	___	___	___	___
Controls								
a. Hot water pump interlock installed.	___	___	___	X	___	___	___	___
b. Hot water pump interlock tested.	___	___	___	X	___	___	___	___

## Pre-commissioning Checklist - Hot Water Boiler

For Boiler: B - 1, B - 2, B - 3, B - 4

Checklist Item	Q	M	E	T	C	D	O	U
c. Hot water heating system balanced.	___	___	X	X	___	___	___	___
d. Hot water heating controls operational.	___	___	X	X	___	___	___	___



## Pre-commissioning Checklist - Unit Heater

For Unit Heater: All Unit Heaters

Checklist Item	Q	M	E	T	C	D	O	U
Installation								
a. Hot water piping properly connected.	___	___	X	___	___	___	___	___
a. Condensate piping properly connected.	___	___	X	X	X	___	___	___
b. Hot water piping pressure tested.	___	___	X	___	___	___	___	___
b. Condensate piping pressure tested.	___	___	X	X	X	___	___	___
c. Air vent installed on hot water coil with shutoff valve as specified.	___	___	X	X	X	___	___	___
d. Any damage to coil fins has been repaired.	___	___	X	___	X	___	___	___
e. Manufacturer's required maintenance/operational clearance provided.	___	___	X	X	X	___	___	___
Electrical								
a. Power available to unit disconnect.	___	___	___	X	___	___	___	___
b. Proper motor rotation verified.	___	___	___	X	X	___	___	___
c. Verify that power disconnect is located within sight of the unit it controls.	___	___	___	X	___	___	___	___
Controls								
a. Control valves properly installed.	___	___	X	___	___	___	___	___
b. Control valves operable.	___	___	X	X	___	___	___	___
c. Verify proper location and installation of thermostat.	___	___	X	___	___	___	___	___
Testing, Adjusting, and Balancing (TAB)								
a. TAB Report submitted.	___	___	X	___	X	___	___	___

## Pre-commissioning Checklist - Exhaust Fan

For Exhaust Fan: All Exhaust Fans

Checklist Item	Q	M	E	T	C	D	O	U
Installation								
a. Fan belt adjusted.	___	___	X	___	X	___	___	___
Electrical								
a. Power available to fan disconnect.	___	___	___	X	___	___	___	___
b. Proper motor rotation verified.	___	___	___	___	X	___	___	___
c. Verify that power disconnect is located within sight of the unit it controls.	___	___	___	X	___	___	___	___
Controls								
a. Control interlocks properly installed.	___	___	___	X	___	___	___	___
b. Control interlocks operable.	___	___	___	X	___	___	___	___
c. Dampers/actuators properly installed.	___	___	X	___	___	___	___	___
d. Dampers/actuators operable.	___	___	X	___	___	___	___	___
e. Verify proper location and installation of thermostat.	___	___	X	___	___	___	___	___
Testing, Adjusting, and Balancing (TAB)								
a. TAB results +10%/-0% to cfm shown on drawings	___	___	X	___	X	___	___	___
b. TAB Report submitted.	___	___	X	___	X	___	___	___

## Pre-commissioning Checklist - Computer Room Unit

For Computer Room Unit: All Computer Units

Checklist Item	Q	M	E	T	C	D	O	U
Installation								
a. Unit properly supported.	___	___	X	X	X	___	___	___
b. Access doors are operable and sealed.	___	___	X	___	X	___	___	___
c. Casing undamaged.	___	___	X	X	X	___	___	___
d. Insulation undamaged.	___	___	X	X	X	___	___	___
e. Condensate drainage is unobstructed and routed to floor drain.	___	___	X	X	X	___	___	___
f. Fan belt adjusted.	___	___	X	___	X	___	___	___
g. Manufacturer's required maintenance operational clearance provided.	___	___	X	X	X	___	___	___
Electrical								
a. Power available to unit disconnect.	___	___	___	X	X	___	___	___
b. Proper motor rotation verified.	___	___	___	___	X	___	___	___
c. Proper motor rotation verified.	___	___	___	___	X	___	___	___
d. Verify that power disconnect is located within sight of the unit it controls.	___	___	___	X	___	___	___	___
Coils/Humidifier								
a. Chilled water piping properly connected.	___	___	X	___	___	___	___	___
a. Refrigerant piping properly connected.	___	___	X	X	X	___	___	___
b. Chilled water piping pressure tested.	___	___	X	X	X	___	___	___
b. Refrigerant piping pressure tested.	___	___	X	X	X	___	___	___
c. Humidifier makeup water connected.	___	___	X	X	X	___	___	___
Controls								
a. Control valves operable.	___	___	X	X	___	___	___	___
b. Unit control system operable and verified.	___	___	___	X	___	___	___	___

## Pre-commissioning Checklist - Computer Room Unit

For Computer Room Unit: All Computer Units

Checklist Item	Q	M	E	T	C	D	O	U
c. Verify proper location and installation of thermostat.	___	___	X	___	___	___	___	___
Testing, Adjusting, and Balancing (TAB)								
a. Construction filters removed and replaced.	___	___	X	___	X	___	___	___
b. TAB results +10%/-0% cfm shown on drawings.	___	___	X	___	X	___	___	___
c. TAB Report submitted.	___	___	X	___	X	___	___	___

## Pre-commissioning Checklist - HVAC System Controls

For HVAC System: The Entire System

Checklist Item	Q	M	E	T	C	D	O	U
Installation								
a. As-built shop drawings submitted.	___	___	X	X	___	___	___	___
b. Layout of control panel matches drawings.	___	___	X	X	___	___	___	___
c. Framed instructions mounted in or near control panel.	___	___	X	X	___	___	___	___
d. Components properly labeled (on inside and outside of panel).	___	___	X	X	___	___	___	___
e. Control components piped and/or wired to each labeled terminal strip.	___	___	X	X	___	___	___	___
f. EMCS connection made to each labeled terminal strip as shown.	___	___	X	X	___	___	___	___
g. Control wiring and tubing labeled at all terminations, splices, and junctions.	___	___	X	X	___	___	___	___
h. Shielded wiring used on electronic sensors.	___	___	X	X	___	___	___	___
i. Water drain installed as specified.	___	___	X	X	___	___	___	___
Main Power and Control Air								
a. 110 volt AC power available to panel.	___	___	___	X	___	___	___	___
b. 20 psig compressed air available to panel.	___	___	X	X	___	___	___	___
Testing, Commissioning, and Balancing								
a. Testing, Commissioning, and Balancing Report submitted.	___	___	X	___	___	___	___	___

APPENDIX B

FUNCTIONAL PERFORMANCE TESTS CHECKLISTS

## Functional Performance Test Checklist - Pumps

For Pump: All Pumps

Prior to performing this checklist, ensure that for closed loop systems, system is pressurized and the make-up water system is operational or, for open loop systems, that the sumps are filled to the proper level.

1. Activate pump start using control system commands (all possible combination, on/auto, etc.). ON\_\_\_\_\_ AUTO\_\_\_\_\_ OFF\_\_\_\_\_

a. Verify pressure drop across strainer:

Strainer inlet pressure \_\_\_\_\_ psig  
Strainer outlet pressure \_\_\_\_\_ psig

b. Verify pump inlet/outlet pressure reading, compare to Testing, Adjusting, and Balancing (TAB) Report, pump design conditions, and pump manufacturer's performance.

DESIGN	TAB	ACTUAL
Pump inlet pressure (psig)	_____	_____
Pump outlet pressure (psig)	_____	_____

c. Operate pump at shutoff and at 100 percent of designed flow when all components are in full flow. Plot test readings on pump curve and compare results against readings taken from flow measuring devices.

	SHUTOFF	100 percent
Pump inlet pressure (psig)	_____	_____
Pump outlet pressure	_____	_____
Pump flow rate (gpm)	_____	_____

d. Operate pump at shutoff and at minimum flow or when all components are in full by-pass. Plot test readings on pump curve and compare results against readings taken from flow measuring devices.

	SHUTOFF	100 percent
Pump inlet pressure (psig)	_____	_____
Pump outlet pressure	_____	_____
Pump flow rate (gpm)	_____	_____

2. Verify motor amperage each phase and voltage phase to phase and phase to ground for both the full flow and the minimum flow conditions.

a. Full flow:

	PHASE 1	PHASE 2	PHASE 3
Amperage	_____	_____	_____
Voltage	_____	_____	_____

## Functional Performance Test Checklist - Pumps

For Pump: All Pumps

Voltage \_\_\_\_\_

Voltage to ground \_\_\_\_\_

b. Minimum flow:

	PHASE 1	PHASE 2	PHASE 3
Amperage	_____	_____	_____
Voltage	_____	_____	_____
Voltage	_____	_____	_____
Voltage to ground	_____	_____	_____

3. Unusual vibration, noise, etc.

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4. Certification: We the undersigned have witnessed the above functional performance tests and certify that the item tested has met the performance requirements in this section of the specifications.

Signature and Date

Contractor's Chief Quality Control Representative \_\_\_\_\_

Contractor's Mechanical Representative \_\_\_\_\_

Contractor's Electrical Representative \_\_\_\_\_

Contractor's Testing, Adjusting and Balancing Representative \_\_\_\_\_

Contractor's Controls Representative \_\_\_\_\_

Contracting Officer's Representative \_\_\_\_\_

Using Agency's Representative \_\_\_\_\_

## Functional Performance Test Checklist - Chiller

For Chiller: CH - 1 &amp; CH - 2

1. Functional Performance Test: Contractor shall demonstrate operation of chilled water system as per specifications including the following: Start building air handler to provide load for chiller. Activate controls system chiller start sequence as follows:

- a. Time of day startup program initiates chiller start: \_\_\_\_\_
- b. Start condenser water pump and establish condenser water flow. Verify chiller condenser water proof-of-flow switch operation. \_\_\_\_\_
- c. Start chilled water pump and establish chilled water flow. Verify chiller chilled water proof-of-flow switch operation. \_\_\_\_\_
- d. Verify control system energizes chiller start sequence. \_\_\_\_\_
- e. Verify chiller senses chilled water temperature above set point and control system activates chiller start.  
\_\_\_\_\_
- f. Verify functioning of "soft start" sequence. \_\_\_\_\_
- g. Shut off air handling equipment to remove load on chilled water system. Verify chiller shutdown sequence is initiated and accomplished after load is removed.  
\_\_\_\_\_
- h. Restart air handling equipment one minute after chiller shut down. Verify condenser water pump, cooling tower, and chiller restart sequence.  
\_\_\_\_\_

2. Certification: We the undersigned have witnessed the above functional performance tests and certify that the item tested has met the performance requirements in this section of the specifications.

Signature and Date

Contractor's Chief Quality Control Representative \_\_\_\_\_

Contractor's Mechanical Representative \_\_\_\_\_

Contractor's Electrical Representative \_\_\_\_\_

Contractor's Testing, Adjusting and Balancing Representative \_\_\_\_\_

Contractor's Controls Representative \_\_\_\_\_

Contracting Officer's Representative \_\_\_\_\_

Functional Performance Test Checklist - Chiller

For Chiller: CH - 1 & CH - 2

Using Agency's Representative

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## Functional Performance Test Checklist - VAV Terminals

The Contracting officer will select VAV terminals to be spot-checked during the functional performance test. The number of terminals shall not exceed 10.

1. Functional Performance Test: Contractor shall demonstrate operation of selected VAV boxes as per specifications including the following:

a. Cooling only VAV boxes:

(1) Verify VAV box response to room temperature set point adjustment. Turn thermostat to 3 degrees C (5 degrees F) above ambient and measure maximum air flow. Turn thermostat to 3 degrees C (5 degrees F) below ambient and measure minimum air flow.

Maximum flow [\_\_\_\_\_] cfm

Minimum flow [\_\_\_\_\_] cfm

(2) Check damper maximum/minimum flow settings.

Maximum flow setting [\_\_\_\_\_] cfm

Minimum flow setting [\_\_\_\_\_] cfm

b. Cooling with reheat VAV boxes:

(1) Verify VAV box response to room temperature set point adjustment. Turn thermostat to 5 degrees F above ambient and measure maximum air flow. Turn thermostat to 5 degrees F below ambient and measure minimum air flow.

Maximum flow [\_\_\_\_\_] cfm

Minimum flow [\_\_\_\_\_] cfm

(2) Check damper maximum/minimum flow settings.

Maximum flow setting [\_\_\_\_\_] cfm

Minimum flow setting [\_\_\_\_\_] cfm

Reheat coil operation range (full open to full closed) \_\_\_\_\_

c. Fan powered VAV boxes:

(1) Verify VAV box response to sensor call for heating via set point adjustment. Changes to be cooling setpoint to heating set point and return to cooling set point. \_\_\_\_\_ Verify cooling damper closes to minimum position, blower fan energizes according to sequence of operation, and upon further drop in space temperature, heating coil activation and deactivation. \_\_\_\_\_

(2) Check primary air damper maximum/minimum flow settings.

## Functional Performance Test Checklist - VAV Terminals

Maximum flow setting [\_\_\_\_\_] cfm

Minimum flow setting [\_\_\_\_\_] cfm

(3) Check blower fan flow. [\_\_\_\_\_] cfm

(4) Verify free operation of fan backdraft damper (insure no primary air is being discharged through the recirculated air register).

---

(5) Verify that no recirculated air is being induced when box is in full cooling.

---

2. Certification: We the undersigned have witnessed the above functional performance tests and certify that the item tested has met the performance requirements in this section of the specifications.

Signature and Date

Contractor's Chief Quality Control Representative

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Contractor's Mechanical Representative

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Contractor's Electrical Representative

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Contractor's Testing, Adjusting and Balancing Representative

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Contractor's Controls Representative

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Contracting Officer's Representative

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Using Agency's Representative

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## Functional Performance Test Checklist - Variable Volume Air Handling Unit

For Air Handling Unit: AHU - 1, AHU - 2, AHU - 3, AHU - 4

Ensure that a slight negative pressure exists on inboard side of the outside air dampers throughout the operation of the dampers. Modulate OA, RA, and EA dampers from fully open to fully closed positions.

1. Functional Performance Test: Contractor shall verify operation of air handling unit as per specification including the following:

a. The following shall be verified when the supply and return fans operating mode is initiated:

(1) All dampers in normal position \_\_\_\_\_

(2) All valves in normal position. \_\_\_\_\_

(3) System safeties allow start if safety conditions are met. \_\_\_\_\_

(4) VAV fan controller shall "soft-start" fan. \_\_\_\_\_

(5) Modulate all VAV boxes to minimum air flow and verify that the static pressure does not exceed the design static pressure Class shown.

---

b. Occupied mode of operation - economizer de-energized.

(1) Outside air damper at minimum position. \_\_\_\_\_

(2) Return air damper open. \_\_\_\_\_

(3) Relief air damper at minimum position. \_\_\_\_\_

(4) Chilled water control valve modulating to maintain leaving air temperature set point.

---

(5) Fan VAV controller receiving signal from duct static pressure sensor and modulating fan to maintain supply duct static pressure set point.

---

c. Occupied mode of operation - economizer energized.

(1) Outside air damper modulated to maintain mixed air temperature set point. \_\_\_\_\_

(2) Relief air damper modulates with outside air damper according to sequence of operation. \_\_\_\_\_

(3) Chilled water control valve modulating to maintain leaving

## Functional Performance Test Checklist - Variable Volume Air Handling Unit

For Air Handling Unit: AHU - 1, AHU - 2, AHU - 3, AHU - 4  
air temperature set point.

---

(4) Hot water control valve modulating to maintain leaving air  
temperature set point. \_\_\_\_\_

(5) Fan VAV controller receiving signal from duct static pressure  
sensor and modulating fan to maintain supply duct static pressure set point.

---

d. Unoccupied mode of operation

(1) All dampers in normal position. \_\_\_\_\_

(2) Verify low limit space temperature is maintained as specified  
in sequence of operation. \_\_\_\_\_

e. The following shall be verified when the supply supply and return  
fans off mode is initiated:

(1) All dampers in normal position. \_\_\_\_\_

(2) All valves in normal position. \_\_\_\_\_

(3) Fan de-energizes. \_\_\_\_\_

f. Verify the chilled water coil control valve operation by setting  
all VAV's to maximum and minimum cooling.

	Max cooling	Min cooling
Supply air volume _____ cfm)	_____	_____

Supply air temp. (_____ degrees F)	_____	_____
------------------------------------	-------	-------

g. Verify safety shut down initiated by smoke detectors. \_\_\_\_\_

h. Verify safety shut down initiated by low temperature protection  
thermostat. \_\_\_\_\_

2. Certification: We the undersigned have witnessed the above functional  
performance tests and certify that the item tested has met the performance  
requirements in this section of the specifications.

Signature and Date

Contractor's Chief Quality Control Representative

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## Functional Performance Test Checklist - Variable Volume Air Handling Unit

For Air Handling Unit: AHU - 1, AHU - 2, AHU - 3, AHU - 4

Contractor's Mechanical Representative \_\_\_\_\_

Contractor's Electrical Representative \_\_\_\_\_

Contractor's Testing, Adjusting and Balancing Representative \_\_\_\_\_

Contractor's Controls Representative \_\_\_\_\_

Contracting Officer's Representative \_\_\_\_\_

Using Agency's Representative \_\_\_\_\_

## Functional Performance Test Checklist - Packaged Air Cooled Chiller

For Chiller: CH - 1 &amp; CH - 2

1. Functional Performance Test: Contractor shall demonstrate operation of chilled water system as per specifications including the following: Start building air handler to provide load for chiller. Activate controls system chiller start sequence as follows.

a. Start chilled water pump and establish chilled water flow. Verify chiller-chilled water proof-of-flow switch operation. \_\_\_\_\_

b. Verify control system energizes chiller start sequence. \_\_\_\_\_

c. Verify chiller senses chilled water temperature above set point and control system activates chiller start.

\_\_\_\_\_

d. Verify functioning of "soft start" sequence. \_\_\_\_\_

e. Shut off air handling equipment to remove load on chilled water system. Verify chiller shutdown sequence is initiated and accomplished after load is removed.

\_\_\_\_\_

f. Restart air handling equipment one minute after chiller shut down. Verify chiller restart sequence.

\_\_\_\_\_

2. Verify chiller inlet/outlet pressure reading, compare to Testing, Adjusting, and Balancing (TAB) Report, chiller design conditions, and chiller manufacturer's performance data.

DESIGN

TAB

ACTUAL

## Functional Performance Test Checklist - Packaged Air Cooled Chiller

For Chiller: CH - 1 &amp; CH - 2

Chiller inlet pressure (psig) \_\_\_\_\_

Chiller outlet pressure (psig) \_\_\_\_\_

3. Verify chiller amperage each phase and voltage phase-to-phase and phase-to-ground.

	PHASE 1	PHASE 2	PHASE 3
Amperage	_____	_____	_____
Voltage	_____	_____	_____
Voltage	_____	_____	_____
Voltage to ground	_____	_____	_____

4. Record the following information:

Ambient dry bulb temperature \_\_\_\_\_ degrees F

Ambient wet bulb temperature \_\_\_\_\_ degrees F

Entering chilled water temperature \_\_\_\_\_ degrees F

Leaving chilled water temperature \_\_\_\_\_ degrees F

5. Unusual vibration, noise, etc.

\_\_\_\_\_

\_\_\_\_\_

6. Certification: We the undersigned have witnessed the above functional performance tests and certify that the item tested has met the performance requirements in this section of the specifications.

Signature and Date

Contractor's Chief Quality Control Representative

\_\_\_\_\_

Contractor's Mechanical Representative

\_\_\_\_\_

Contractor's Electrical Representative

\_\_\_\_\_

Contractor's Testing, Adjusting and Balancing Representative

\_\_\_\_\_

Contractor's Controls Representative

\_\_\_\_\_

Contracting Officer's Representative

\_\_\_\_\_

Using Agency's Representative

\_\_\_\_\_

## Functional Performance Test Checklist - Air Cooled Condensing Unit

For Condensing Unit: Computer Unit, Dry Cooler

1. Functional Performance Test: Contractor shall demonstrate operation of refrigeration system as per specifications including the following: Start building air handler to provide load for condensing unit. Activate controls system start sequence as follows.

a. Start air handling unit. Verify control system energizes condensing unit start sequence. \_\_\_\_\_

b. Shut off air handling equipment to verify condensing unit de-energizes. \_\_\_\_\_

c. Restart air handling equipment one minute after condensing unit shut down. Verify condensing unit restart sequence. \_\_\_\_\_

2. Verify condensing unit amperage each phase and voltage phase to phase and phase to ground.

	PHASE 1	PHASE 2	PHASE 3
Amperage	_____	_____	_____
Voltage	_____	_____	_____
Voltage	_____	_____	_____
Voltage to ground	_____	_____	_____

3. Record the following information:

Ambient dry bulb temperature	_____	degrees F
Ambient wet bulb temperature	_____	degrees F
Suction pressure	_____	psig
Discharge pressure	_____	psig

4. Unusual vibration, noise, etc.

\_\_\_\_\_

\_\_\_\_\_

5. Certification: We the undersigned have witnessed the above functional performance tests and certify that the item tested has met the performance requirements in this section of the specifications.

Signature and Date

Contractor's Chief Quality Control Representative

\_\_\_\_\_

Contractor's Mechanical Representative

\_\_\_\_\_

Functional Performance Test Checklist - Air Cooled Condensing Unit

For Condensing Unit: Computer Unit, Dry Cooler

Contractor's Electrical Representative Representative

\_\_\_\_\_

Contractor's Testing, Adjusting and Balancing

\_\_\_\_\_

Contractor's Controls Representative

\_\_\_\_\_

Contracting Officer's Representative

\_\_\_\_\_

Using Agency's Representative

\_\_\_\_\_

## Functional Performance Test Checklist - Hot Water Boiler

For Boiler: B - 1, B - 2, B - 3, B - 4

1. Functional Performance Test: Contractor shall demonstrate operation of hot water system as per specifications including the following: Start building heating equipment to provide load for boiler. Activate controls system boiler start sequence as follows.

a. Start hot water pump and establish hot water flow. Verify boiler hot water proof-of-flow switch operation. \_\_\_\_\_

b. Verify control system energizes boiler start sequence. \_\_\_\_\_

c. Verify boiler senses hot water temperature below set point and control system activates boiler start. \_\_\_\_\_

d. Shut off building heating equipment to remove load on hot water system. Verify boiler shutdown sequence is initiated and accomplished after load is removed. \_\_\_\_\_

2. Verify boiler inlet/outlet pressure reading, compare to Test and Balance (TAB) Report, boiler design conditions, and boiler manufacturer's performance data.

	DESIGN	TAB	ACTUAL
Boiler inlet pressure (psig)	_____	_____	_____
Boiler outlet pressure (psig)	_____	_____	_____
Boiler flow rate (gpm)	_____	_____	_____
Flue-gas temperature at boiler outlet	_____	_____	_____
Percent carbon dioxide in flue-gas	_____	_____	_____
Draft at boiler flue-gas exit	_____	_____	_____
Draft or pressure in furnace	_____	_____	_____
Stack emission pollutants concentration	_____	_____	_____
Fuel type	_____	_____	_____
Combustion efficiency	_____	_____	_____

3. Record the following information:

Ambient temperature	_____	degrees F
Entering hot water temperature	_____	degrees F
Leaving hot water temperature	_____	degrees F

4. Verify temperatures in item 3 are in accordance with the reset schedule. \_\_\_\_\_

5. Verify proper operation of boiler safeties. \_\_\_\_\_

Functional Performance Test Checklist - Hot Water Boiler

For Boiler: B - 1, B - 2, B - 3, B - 4

6. Unusual vibration, noise, etc.

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7. Visually check refractory for cracks or spalling and refractory and tubes for flame impingement. \_\_\_\_\_

8. Certification: We the undersigned have witnessed the above functional performance tests and certify that the item tested has met the performance requirements in this section of the specifications.

Signature and Date

Contractor's Chief Quality Control Representative

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Contractor's Mechanical Representative

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Contractor's Electrical Representative

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Contractor's Testing, Adjusting and Balancing Representative

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Contractor's Controls Representative

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Contracting Officer's Representative

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Using Agency's Representative

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## Functional Performance Test Checklist - Unit Heaters

The Contracting Officer will select unit heaters to be spot-checked during the functional performance test. All Units Heaters shall be checked.

1. Functional Performance Test: Contractor shall demonstrate operation of selected unit heaters as per specifications including the following:

a. Verify unit heater response to room temperature set point adjustment. Changes to be heating set point to heating set point minus 10 degrees and return to heating set point. \_\_\_\_\_

b. Check blower fan speed. \_\_\_\_\_rpm

c. Check heating mode inlet air temperature. Check heating mode inlet air temperature. \_\_\_\_\_ degrees F

d. Check heating mode outlet air temperature. Check heating mode outlet air temperature. \_\_\_\_\_ degrees F

2. Certification: We the undersigned have witnessed the above functional performance tests and certify that the item tested has met the performance requirements in this section of the specifications.

Signature and Date

Contractor's Chief Quality Control Representative

\_\_\_\_\_

Contractor's Mechanical Representative

\_\_\_\_\_

Contractor's Electrical Representative

\_\_\_\_\_

Contractor's Testing, Adjusting and Balancing Representative

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Contractor's Controls Representative

\_\_\_\_\_

Contracting Officer's Representative

\_\_\_\_\_

Using Agency's Representative

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## Functional Performance Test Checklist - Computer Room Unit

For Computer Room Unit: All Computer Units

1. Functional Performance Test: Contractor shall verify operation of computer room unit as per specification including the following:

- a. System safeties allow start if safety conditions are met. \_\_\_\_\_
- b. Verify cooling and heating operation by varying thermostat set point from space set point to space set point plus 10 degrees, space set point minus 10 degrees, and returning to space set point. \_\_\_\_\_
- c. Verify humidifier operation by varying humidistat set point from space set point to space set point plus 20 percent RH, and returning to space set point.  
\_\_\_\_\_
- d. Verify that airflow is within +10/-0 percent of design airflow.  
\_\_\_\_\_
- e. Verify unit shut down during fire event initiated by smoke/heat sensors. \_\_\_\_\_

2. Certification: We the undersigned have witnessed the above functional performance tests and certify that the item tested has met the performance requirements in this section of the specifications.

Signature and Date

Contractor's Chief Quality Control Representative \_\_\_\_\_

Contractor's Mechanical Representative \_\_\_\_\_

Contractor's Electrical Representative \_\_\_\_\_

Contractor's Testing, Adjusting and Balancing Representative \_\_\_\_\_

Contractor's Controls Representative \_\_\_\_\_

Contracting Officer's Representative \_\_\_\_\_

Using Agency's Representative \_\_\_\_\_

## Functional Performance Test Checklist - HVAC Controls

For HVAC System: Main Building HVAC System ("Front End") and Each Air Handling Unit

The Contracting Officer will select HVAC control systems to undergo functional performance testing. The number of systems shall not exceed 10 percent.

1. Functional Performance Test: Contractor shall verify operation of HVAC controls by performing the following tests:

a. Verify that controller is maintaining the set point by manually measuring the controlled variable with a thermometer, sling psychrometer, inclined manometer, etc.

b. Verify sensor/controller combination by manually measuring the controlled medium. Take readings from control panel display and compare readings taken manually. Record all readings.

Sensor \_\_\_\_\_  
Manual measurement \_\_\_\_\_  
Panel reading value \_\_\_\_\_

c. Verify system stability by changing the controller set point as follows:

- (1) Air temperature - minus 12 degrees C (10 degrees F)
- (2) Water temperature - minus 12 degrees C (10 degrees F)
- (3) Static pressure - 10 percent of set point
- (4) Relative humidity - percent (RH)

The control system shall be observed for 10 minutes after the change in set point. Instability or excessive hunting will be unacceptable.

d. Verify interlock with other HVAC controls.

e. Verify interlock with fire alarm control panel.

f. Verify interlock with EMCS.

g. Change controller set point 10 percent with EMCS and verify correct response.

2. Verify that operation of control system conforms to that specified in the sequence of operation.

3. Certification: We the undersigned have witnessed the above functional performance tests and certify that the item tested has met the performance requirements in this section of the specifications.

Functional Performance Test Checklist - HVAC Controls

For HVAC System: Main Building HVAC System ("Front End") and Each Air Handling Unit

Signature and Date

Contractor's Chief Quality Control Representative \_\_\_\_\_

Contractor's Mechanical Representative \_\_\_\_\_

Contractor's Electrical Representative \_\_\_\_\_

Contractor's Testing, Adjusting and Balancing Representative  
\_\_\_\_\_

Contractor's Controls Representative \_\_\_\_\_

Contractor's Officer's Representative \_\_\_\_\_

Using Agency's Representative \_\_\_\_\_

-- End of Section --

## DIRECT DIGITAL CONTROLS FOR HVAC (NETWORKED BUILDING CONTROLLER)

### PART 1: GENERAL –

Presently, Fort Drum has a Base-Wide Central Direct Digital Control System for over 70 buildings inside the Fort. Their current system is a Trane Tracer Summit Direct Digital Control System, which is able to monitor and control all their Networked building facilities for utilities; and Heating, Ventilation, and Air Conditioning (HVAC), demands. The Central Control location is the Central Heat Shop located inside Fort Drum. At present, communication is established by DialUp Modem to each building. It is an absolute requirement that any approved system be based on ASHRAE/ANSI 1351995 (BACnet), and the interface between the approved Control System and work be fully integrated into the Base-Wide existing System; and interoperability be seamless and fully compatible.

Additionally, Contractor shall provide one complete DeskTop Work-Station capable of providing building local control. The exact location placement inside the building shall be as designated by the COR.

#### 1.01 SECTION INCLUDES

- A. Products Furnished But Not Installed Under This Section
- B. Products Installed But Not Furnished Under This Section
- C. Related Sections
- D. Description
- E. Approved Control System Contractor
- F. Quality Assurance
- G. System Performance
- H. Submittals
- I. Warranty
- J. Ownership of Proprietary Material

#### 1.02 PRODUCTS FURNISHED BUT NOT INSTALLED UNDER THIS SECTION

- A. See other Contract Specifications Sections under 1500s series.

#### 1.03 PRODUCTS INSTALLED BUT NOT FURNISHED UNDER THIS SECTION

- A. See other Contract Specifications Sections under 1500s and 1600s series.

#### 1.04 RELATED SECTIONS

- A. The General Conditions of the Contract, Supplementary Conditions, and General Requirements are a part of these Specifications and shall be used in conjunction with this Section as a part of the Contract Documents. Consult them for further instructions pertaining to this work. The Contractor is bound by the provisions of all other sections listed under this Contract.

#### 1.05 DESCRIPTION

- A. General: The control system shall be as indicated and described in the Contract Plans and Specifications.
- B. Direct Digital Control (DDC) technology shall be used to provide the functions necessary for control of mechanical systems on this project.
- C. The control system shall accommodate simultaneous multiple user operation. Access to the control system data should be limited only by operator password. Multiple users shall have access to all valid system data. An operator shall be able to log onto anywork-station on the control system and have access to all appropriate data.
- D. The control system shall be designed such that each mechanical system will be able to operate under stand-alone control. As such, in the event of a network communication failure, or the loss of any other controller, the control system shall continue to independently operate under control.
- E. Communication between the control panels and all workstations shall be over a high speed network. All nodes on this network shall be peers. The operator shall not have to know the panel identifier or location to view or control an object. Application Specific Controllers shall be constantly scanned by the network controllers to update point information and alarm information.
- F. The Contractor shall provide hardware and software necessary to implement the functions and sequences.

#### 1.06 APPROVED CONTROL SYSTEM MANUFACTURER

- A. See paragraph above, under, PART 1: GENERAL

#### 1.07 QUALITY ASSURANCE

- A. System Installer Qualifications
  - 1. The Installer shall have an established working relationship with the Control System Manufacturer of not less than three years.
  - 2. The Installer shall have successfully completed Control System Manufacturer's classes on the control system. The Installer shall present for review the certification of completed training, including the hours of instruction and course outlines upon request.
  - 3. The installer shall have an office within 125 miles of the project site and provide 24 hour response in the event of a customer call.
- B. Codes and Standards: Meet requirements of all applicable standards and codes, except when more detailed or stringent requirements are indicated by the Contract Documents, including requirements of this Section.
  - 1. Underwriters Laboratories: Products shall be UL-916-PAZX listed.

2. National Electrical Code-- NFPA 70.
  3. Federal Communications Commission-- Part J.
  4. ASHRAE/ANSI 135-1995 (BACnet)
- C. All products used in this installation shall be new, currently under manufacture, and shall be applied in similar installations for a minimum of 2 years. This installation shall not be used as a test site for any new products unless explicitly approved by the Contracting Officer Representative (COR) in writing prior to bid date. Spare parts shall be available for at least 5 years after completion of this contract.

## 1.08 SYSTEM PERFORMANCE

- A. Performance Standards. The system shall conform to the following:
1. Graphic Display. The system shall display a graphic with a minimum of 20 dynamic points. All current data shall be displayed within 20 seconds of the request.
  2. Graphic Refresh. The system shall update all dynamic points with current data within 30 seconds.
  3. Object Command. The maximum time between the command of a binary object by the operator and the reaction by the device shall be 10 seconds. Analog objects shall start to adjust within 10 seconds.
  4. Object Scan. All changes of state and change of analog values shall be transmitted over the high-speed network such that any data used or displayed at a controller or work-station will be current, within the prior 60 seconds.
  5. Alarm Response Time. The maximum time from when an object goes into alarm to when it is annunciated at the workstation shall not exceed 45 seconds.
  6. Program Execution Frequency. Custom and standard applications shall be capable of running as often as once every 5 seconds. The Contractor shall be responsible for selecting execution times consistent with the mechanical process under control.
  7. Performance. Programmable Controllers shall be able to execute DDC PID control loops at a selectable frequency from at least once every 5 seconds. The controller shall scan and update the process value and output generated by this calculation at this same frequency.
  8. Multiple Alarm Annunciation. All workstations on the network shall receive alarms within 5 seconds of each other.
  9. Reporting Accuracy. Table 1 lists minimum acceptable reporting accuracies for all values reported by the specified system.

**Table I -- Reporting Accuracy**

<b>Measured Variable</b>	<b>Reported Accuracy</b>
Space temperature	$\pm 0.5^{\circ}\text{C}$ [ $\pm 1^{\circ}\text{F}$ ]
Ducted air	$\pm 1.0^{\circ}\text{C}$ [ $\pm 2^{\circ}\text{F}$ ]
Outside air	$\pm 1.0^{\circ}\text{C}$ [ $\pm 2^{\circ}\text{F}$ ]
Water temperature	$\pm 0.5^{\circ}\text{C}$ [ $\pm 1^{\circ}\text{F}$ ]
Delta-T	$\pm 0.15^{\circ}\text{C}$ [ $\pm 0.25^{\circ}\text{F}$ ]
Relative humidity	$\pm 5\%$ RH
Water flow	$\pm 5\%$ of full scale
Air flow (terminal)	$\pm 10\%$ of reading *Note 1
Air flow (measuring stations)	$\pm 5\%$ of reading
Air pressure (ducts)	$\pm 25$ Pa [ $\pm 0.1$ "W.G.]
Air pressure (space)	$\pm 3$ Pa [ $\pm 0.01$ "W.G.]
Water pressure	$\pm 2\%$ of full scale *Note 2
Electrical Power	$5\%$ of reading *Note 3
Carbon Monoxide (CO)	$\pm 50$ PPM
Carbon Dioxide (CO <sub>2</sub> )	$\pm 50$ PPM

Note 1: (10%-100% of scale) (cannot read accurately below 10%)

Note 2: for both absolute and differential pressure

Note 3: \* not including utility supplied meters

#### 1.09 SUBMITTALS

- A. Contractor shall provide shop drawings and manufacturers' standard specification data sheets on all hardware and software to be provided. No work may begin on any segment of this project until submittals have been reviewed by the Government for conformity with the plan and specifications. Seven (7) copies are required. All shop drawings shall be done on MicroStation, or AutoCAD, and provided to the Owner on one 3.5" floppy diskette, or a CD ROM.
- B. Quantities of items submitted shall be reviewed by the Government. Such review shall not relieve the contractor from furnishing quantities required for completion.
- C. Provide the COR any additional information or data which is deemed necessary to determine compliance with these specifications or which is deemed valuable in documenting the system to be installed.
- D. Submit the following within 240 days of contract award:
  - 1. A complete bill of materials of equipment to be used indicating quantity, manufacturer and model number.
  - 2. A schedule of all control valves including the valve size, model number (including pattern and connections), flow, CV, pressure rating, and location.
  - 3. A schedule of all control dampers. This shall include the damper size, pressure drop, manufacturer and model number.
  - 4. Provide manufacturers cut sheets for major system components. When manufacturer's cut sheets apply to a product series rather than a specific product, the data specifically applicable to the project shall be highlighted or clearly

indicated by other means. Each submitted piece of literature and drawings shall clearly reference the specification and/or drawing that the submittal is being submitted to cover. Include:

- a. Building Controllers
- b. Custom Application Controllers
- c. Application Specific Controllers
- d. Operator Interface Computer
- e. Portable Operator Workstation
- f. Auxiliary Control Devices
- g. Proposed control system riser diagram showing system configuration, device locations, addresses, and cabling.
- h. Detailed termination drawings showing all required field and factory terminations. Terminal numbers shall be clearly labeled.
- i. Points list showing all system objects, and the proposed English language object names.
- j. Sequence of operations for each system under control. This sequence shall be specific for the use of the Control System being provided for this project.
- k. Provide a BACnet Product Implementation Conformance Statement (PICS) for each BACnet device type in the submittal.
- l. Color prints of proposed graphics with a list of points for display.

E. Project Record Documents: Upon completion of installation submit three (3) copies of record (as-built) documents. The documents shall be submitted for approval prior to final completion and include:

1. Project Record Drawings - These shall be as-built versions of the submittal shop drawings. One set of magnetic media including CAD .DWG or .DGN drawing files shall also be provided.
2. Testing and Commissioning Reports and Checklists.
3. Operating and Maintenance (O & M) Manual - These shall be as-built versions of the submittal product data. In addition to that required for the submittals, the O & M manual shall include:
  - a. Names, address and 24-hour telephone numbers of Contractors installing equipment, and the control systems and service representative of each.
  - b. Operators Manual with procedures of operating the control systems including logging on/off, alarm handling, producing point reports, trending data, overriding computer control, and changing set points and other variables.
  - c. Programming Manual with a description of the programming language including syntax, statement descriptions including algorithms and calculations used, point database creation and modification, program creation and modification, and use of the editor.
  - d. Engineering, Installation and Maintenance Manual(s) that explains how to design and install new points, panels, and other hardware; preventative maintenance and calibration procedures; how to debug hardware problems; and how to repair or replace hardware.

- e. A listing and documentation of all custom software created using the programming language including the point database. One set of magnetic media containing files of the software and database shall also be provided
  - f. One set of magnetic media containing files of all colorgraphic screens created for the project.
  - g. A list of recommended spare parts with part numbers and supplier.
  - h. Complete original issue documentation, installation and maintenance information for all third party hardware provided including computer equipment and sensors.
  - i. Complete original issue diskettes for all software provided including operating systems, programming language, operator workstation software, and graphics software.
  - j. Licenses, Guarantee, and Warrantee documents for all equipment and systems.
  - k. Recommended preventive maintenance procedures for all system components including a schedule of tasks (inspection, cleaning, calibration, etc.), time between tasks, and task descriptions.
- F. Training Manuals: The Contractor shall provide a course outline and training manuals for all training classes at least six weeks prior to the first class. The Government reserves the right to modify any or all of the training course outline and training materials. Review and approval by the Government shall be completed at least 5 weeks prior to first class.

#### 1.10 WARRANTY

- A. Warrant all work as follows:
- 1. Labor & materials for control system specified shall be warranted free from defects for a period of twelve (12) months after final completion acceptance by the Owner. Control System failures during the warranty period shall be adjusted, repaired, or replaced at no charge or reduction in service to the Government. The Contractor shall respond to the Government's request for warranty service within 24 hours during customary business hours.
  - 2. At the end of the final start-up/testing, if equipment and systems are operating satisfactorily to the Government, the Government Representatives shall sign certificates certifying that the control system's operation has been tested and accepted in accordance with the terms of this specification. The date of Government's acceptance shall be the start of warranty.
  - 3. Operator work-station software, project specific software, graphics, database, and firmware updates shall be provided to the Government at no charge during the warranty period. Written authorization by the Government must, however, be granted prior to the installation of such changes.

#### 1.11 OWNERSHIP OF PROPRIETARY MATERIAL

- A. All project developed hardware and software shall become the property of the Owner. These include but are not limited to:
- 1. Project graphic images,
  - 2. Record drawings,

3. Project database,
4. Job-specific application programming code,
5. All documentation.

## PART 2: PRODUCTS

### 2.01 SECTION INCLUDES

- A. Acceptable Manufacturers
- B. Operator Interface
- C. System Software
- D. Building Controllers
- E. Custom Application Controllers
- F. Application Specific Controllers
- G. Communications
- H. Input/Output Interface
- I. Auxiliary Control Devices

### 2.02 ACCEPTABLE MANUFACTURERS

- A. See paragraph above, PART 1: GENERAL

### 2.03 OPERATOR INTERFACE

- A. Operator Interface. Furnish one (1) PC based workstations. Each of these work-stations shall be able to access all information in the system. These workstations shall reside on the same high speed network as the building controllers, and also be able to dial into the system. Provide Modem for dialup.
- B. Work-station information access shall use the BACnet Protocol. Communication shall use the ISO 8802-3 (Ethernet) or ARCNET (ASTM 878.1) Physical/Data Link layer protocol. Remote communications shall use the BACnet Point to Point Physical/Data Link Layer Protocol.
- C. Hardware. Each operator work-station shall consist of the following:
  1. Personal Computer. Furnish IBM compatible PCs as shown on the drawings. The CPU shall be a minimum of an Intel Pentium and operate at a minimum of 500 MHz. A minimum of 128 Megabytes of RAM, one 1.44 Megabyte 3.5 inch diskette drive, 32X CD ROM drive, and a 10 Gigabyte hard disk with a minimum access time of 12 milliseconds shall be provided. A two button mouse will also be provided. Furnish all required serial, parallel, and network communication ports, and all cables for proper system operation. The PC shall have a minimum of a 17" SVGA monitor.
  2. Modems. Furnish auto-dial telephone modems and associated cables as required for communication to remote buildings, and work stations. The modem shall

transmit at a minimum of 56.6 K baud, and communicate over voicegrade telephone lines.

3. Printers. Each work station shall have 1 printers, with tractor feed, and associated cables. Each printer shall be capable of a minimum 160 characters per second operation and be compatible with standard parallel or serial communications. Supply one box of minimum 2000 sheets of printer paper and two (2) printer ribbons or cartridges.
4. BACnet. The PCWS shall use the Read (Initiate) and Write (Execute) Services as defined in Clauses 15.5 and 15.8, respectively, of ASHRAE Standard 135-95, to communicate with BACnet objects in the internetwork. Objects supported shall include: Analog input, analog output, analog value, binary input, binary output, binary value, device.

D. System Software

1. Operating System. Furnish a commercially available, concurrent multitasking operating system. The operating system shall also support the use of other common software applications that operate under DOS or Microsoft Windows. Acceptable operating systems are Windows NT, and Windows 2000.
2. System Graphics. The Operator Work-station software shall be graphically oriented. The system shall allow display of up to 10 graphic screens at once for comparison and monitoring of system status. Provide a method for the operator to easily move between graphic displays and change the size and location of graphic displays on the screen. The system graphics shall be able to be modified while on line. An operator with the proper password level shall be able to add, delete, or change dynamic points on a graphic. Dynamic points shall include analog and binary values, dynamic text, static text, and animation files. Graphics shall have the ability to show animation of equipment.
  - a. Custom Graphics. Custom graphic files shall be created with the use of commonly available graphics packages such as PC Paint. The graphics generation package shall create and modify graphics that are saved in industry standard formats such as PCX, BMP, GIF and JPEG. The graphics generation package shall also provide the capability of capturing or converting graphics from other programs such as Designer, or AutoCAD.
  - b. Graphics Library. Furnish a complete library of standard HVAC equipment such as chillers, boilers, air handlers, terminals, fan coils, and unit ventilators. This library shall also include standard symbols for other equipment including fans, pumps, coils, valves, piping, dampers, and duct-work. The library shall be furnished in a file format compatible with the graphics generation package program.
  - c. Engineering Units. Allow for selection of the desired engineering units (i.e. Inch pound or SI) in the system. Unit selection shall be able to be customized by locality to select the desired units for each measurement. Engineering units on this project shall be: Standard Inch Pound.

- E. System Applications. Each workstation shall provide operator interface and offline storage of system information. Provide the following applications at each workstation.
1. Automatic System Database Save and Restore. Each workstation shall store on the hard disk a copy of the current database of each building controller. This database shall be updated whenever a change is made in any panel in the system. The storage of this data shall be automatic and not require operator intervention. In the event of a database loss in a building management panel, the first workstation to detect the loss shall automatically restore the database for that panel.
  2. Manual Database Save and Restore. A system operator with the proper password clearance shall be able to archive the database from any system panel and store on magnetic media. The operator shall also be able to clear a panel database and manually initiate a download of a specified database to any panel in the system.
  3. System Configuration. The workstation software shall provide a graphical method of configuring the system. The user with proper security shall be able to add new devices, and assign modems to devices. This shall allow for future system changes or additions.
  4. On-Line Help. Provide a context sensitive, on line help system to assist the operator in operation and editing of the system. On line help shall be available for all applications and shall provide the relevant data for that particular screen. Additional help information shall be available through the use of hypertext.
  5. Security. Each operator shall be required to log on to the system with a user name and password in order to view, edit, add, or delete data. System security shall be selectable for each operator. The system supervisor shall have the ability to set passwords and security levels for all other operators. Each operator password shall be able to restrict the operators access for viewing and/or changing each system application, full screen editor, and object. Each operator shall automatically be logged off of the system if no keyboard or mouse activity is detected. This auto logoff time shall be set per operator password. All system security data shall be stored in an encrypted format.
  6. System Diagnostics. The system shall automatically monitor the operation of all work-stations, printers, modems, network connections, building management panels, and controllers. The failure of any device shall be annunciated to the operator.
  7. Alarm Processing. Any object in the system shall be configurable to alarm in and out of normal state. The operator shall be able to configure the alarm limits, warning limits, states, and reactions for each object in the system.
    - a. Alarm Reactions. The operator shall be able to determine what actions, if any, are to be taken, by object (or point), during an alarm. Actions shall include logging, printing, starting programs, displaying messages, dialing out to remote stations, paging, providing audible annunciation or displaying specific system graphics. Each of these actions shall be configurable by workstation and time of day. An object in alarm that has

not been acknowledged within an operator specified time period shall be re-routed to an alternate operator specified alarm receipt device.

- b. Binary Alarms. Each binary object shall be set to alarm based on the operator specified state. Provide the capability to disable alarming when the associated equipment is turned off or is being serviced.
  - c. Analog Alarms. Each analog object shall have both high and low alarm limits and warning limits. Alarming must be able to be automatically and manually disabled.
- 8. Trend Logs. The operator shall be able to define a custom trend log for any data in the system. This definition shall include interval, start time, and stop time. Trend intervals of 1, 5, 15, 30, and 60 minutes as well as once a shift (8 hours), once a day, once a week, and once a month shall be selectable. All trends shall start based on the hour. Each trend shall accommodate up to 64 system objects. The system operator with proper password shall be able to determine how many samples are stored in each trend. Trend data shall be sampled and stored on the Building Controller panel and be archived on the hard disk. Trend data shall be able to be viewed and printed from the operator interface software. Trends must be viewable in a text based format or graphically. They shall also be storable in a tab delimited ASCII format for use by other industry standard word processing and spreadsheet packages.
  - 9. Dynamic Graphical Charting. The operator shall be able to select system values to be charted in real time. Up to three values at one time can be selected for each chart. The type of chart (bar, line, 3-D, etc.) shall be selectable.
  - 10. Alarm and Event Log. The operator shall be able to view all logged system alarms and events from any location in the system. Events shall be listed chronologically. An operator with the proper security level may acknowledge and clear alarms. All that have not been cleared by the operator shall be archived to the hard disk on the workstation.
  - 11. Object and Property Status and Control. Provide a method for the operator with proper password protection to view, and edit if applicable, the status of any object and property in the system. These statuses shall be available by menu, on graphics, or through custom programs.
  - 12. Clock Synchronization. The real time clocks in all building control panels and work-stations shall be synchronized on command of an operator. The system shall also be able to automatically synchronize all system clocks, daily from any operator designated device in the system. The system shall automatically adjust for daylight savings and standard time if applicable.
  - 13. Reports and Logs. Provide a reporting package that allows the operator to select, modify, or create reports. Each report shall be definable as to data content, format, interval, and date. Report data shall be archived on the hard disk for historical reporting. Provide the ability for the operator to obtain real time logs of designated lists of objects. Reports and logs shall be stored on the PC hard disk in a format that is readily accessible by other standard software applications.

including spreadsheets and word processing. Reports and logs shall be readily printed to the system printer. The operator shall be able to designate reports that shall be printed or stored to disk at selectable intervals.

- a. Custom Reports: Provide the capability for the operator to easily define any system data into a daily, weekly, monthly, or annual report. These reports shall be time and date stamped and shall contain a report title and the name of the facility.
- b. Standard Reports. The following standard system reports shall be provided for this project. These reports shall be readily customized to the project by the owner.
  - i. Electrical Meter Report: Provide a monthly report showing the daily electrical consumption and peak electrical demand for each building meter. Provide an annual (12 month) summary report showing the monthly electrical consumption and peak demand for each meter.
  - ii. Gas Meter Report: Provide a monthly report showing the daily natural gas consumption for each meter. Provide an annual (12 month) report that shows the monthly consumption for each meter.
  - iii. Weather Data Report: Provide a monthly report showing the daily minimum, maximum and average outdoor air temperature and the number of heating and cooling degree days for each day. Provide an annual (12 month) report showing the minimum, maximum and average outdoor air temperature for the month and the number of heating and cooling degree days for the month.
  - iv. Tenant Override Reports: Provide a monthly report showing the daily total time in hours that each tenant has requested after hours HVAC and lighting services. Provide an annual summary report that shows the override usage on a monthly basis.
  - v. ASHRAE Guideline 3-1996 Report: Provide a daily report that shows the operating condition of each chiller as required by ASHRAE Guideline 3. At minimum this report shall include:
    - (1) Chilled Water (or other fluid) inlet and outlet temperature
    - (2) Chilled Water (or other fluid) flow
    - (3) Chilled Water (or other fluid) inlet and outlet pressures
    - (4) Evaporator refrigerant pressure and temperature
    - (5) Condensor refrigerant pressure and liquid temperature
    - (6) Condensor water inlet and outlet temperatures
    - (7) Condensor water flow
    - (8) Refrigerant levels
    - (9) Oil pressure and temperature
    - (10) Oil level (if applicable)
    - (11) Compressor refrigerant discharge temperature
    - (12) Compressor refrigerant suction temperature

- (13) Manual entry field for addition of refrigerant
- (14) Manual entry field for addition of oil
- (15.) Manual entry field for vibration levels
- (16.) Motor amperes per phase
- (17.) Motor volts per phase
- (18.) PPM refrigerant monitor levels
- (19.) Purge exhaust time or discharge count
- (20.) Ambient temperatures (dry bulb and wet bulb)
- (21.) Date and time data logged

F. Work-station Applications Editors. Each PC work-station shall support full screen editing of all system applications. Provide editors for each application at the PC workstation. The applications shall be downloaded and executed at the appropriate controller panels.

1. Controller. Provide a full screen editor for each type controller and application, that shall allow the operator with proper password to view and change the configuration, name, control parameters, and system setpoints.
2. Scheduling. An editor for the scheduling application shall be provided at each work-station. Provide a monthly calendar for each schedule. Exception schedules and holidays shall be shown clearly on the calendar. Provide a method for allowing several related objects to follow a schedule. The advance and delay time for each object shall be adjustable from this master schedule.
  - a. An operator with proper password level shall be able to modify the schedule. Schedules shall be able to be easily copied between objects and/or dates.
3. Equipment Coordination. Provide a full screen editor that allows equipment to be grouped for proper operation as specified in the sequence of operations. This shall include the coordination of VAV boxes with their associated Air Handling Equipment.
4. Chiller System - The chiller plant control application shall be configured using a full screen editor and shall provide operating status for the system. The display shall include:
  - a. System mode of the chiller plant
  - b. Chiller enable/disable status
  - c. System supply water setpoint
  - d. System supply and return water temperature
  - e. System Chilled water pump status
  - f. System Chilled water flow
  - g. Bypass pipe flow rate (if applicable)
  - h. Current chiller plant control operation
  - i. Add information
  - j. Subtract information
  - k. System failure information
  - l. Chiller failure information
  - m. Rotation information

- n. Override capabilities to force an add control, subtract control, or change of sequence.
  - o. Remove a chiller from a sequence temporarily for service purposes.
5. Custom Application Programming. Provide the tools to create, modify, and debug custom application programming. The operator shall be able to create, edit, and download custom programs at the same time that all other system applications are operating. The system shall be fully operable while custom routines are edited, compiled, and downloaded. The programming language shall have the following features:
- a. The language shall be English language oriented and be based on the syntax of programming languages such as BASIC. It shall allow for free form or fill in the blank programming. Alternatively, the programming language can be graphically-based using function blocks as long as blocks are available that directly provide the functions listed below, and that custom or compound function blocks can be created.
  - b. A full screen character editor/programming environment shall be provided. The editor shall be cursor/mousedriven and allow the user to insert, add, modify, and delete code from the custom programming. It shall also incorporate word processing features such as cut/paste and find/replace.
  - c. The programming language shall allow independently executing program modules to be developed. Each module shall be able to independently enable and disable other modules.
  - d. The editor/programming environment shall have a debugging/simulation capability that allows the user to step through the program and to observe any intermediate values and or results. The debugger shall also provide error messages for syntax and execution errors.
  - e. The programming language shall support conditional statements (IF/THEN/ELSE/ELSE-IF) using compound Boolean (AND, OR, and NOT) and/or relations (EQUAL, LESS THAN, GREATER THAN, NOT EQUAL) comparisons.
  - f. The programming language shall support floating point arithmetic using the following operators: +, -, /, x, square root, and xy. The following mathematical functions shall also be provided: natural log, log, absolute value, and minimum/maximum value from a list of values.
  - g. The programming language shall have predefined variables that represent clock time, day of the week, and date. Variables that provide interval timing shall also be available. The language shall allow for computations using these values.
  - h. The programming language shall have ability to predefined variables representing the status and results of the System Software, and shall be

able to enable, disable, and change the values of BACnet objects in the system.

- G. Portable Operator's Terminal. Furnish a Portable Operator's Terminal that shall be capable of accessing all system data. This device may be connected to any point on the system inter-network or may be connected directly to any controller for programming, set up, and troubleshooting. BACnet. The Portable Operators Terminal shall use the Read (Initiate) and Write (Execute) Services as defined in Clauses 15.5 and 15.8, respectively, of ASHRAE Standard 135-95, to communicate with BACnet objects in the internetwork. Objects supported shall include: Analog input, analog output, analog value, binary input, binary output, binary value, device.

The Portable Operator's Terminal shall be an IBM compatible notebookstyle PC including all software and hardware required. The PC shall contain at minimum:

1. 350 MHz Intel Pentium Processor
2. 64 MB RAM
3. 4 Gbyte Hard File
4. 3.5" 1.44 MB Floppy Disk Drive
5. 16X CD ROM Drive

## 2.04 SYSTEM SOFTWARE

- A. Furnish the following applications software for building and energy management. All software applications shall reside and run in the system controllers. Editing of applications shall occur at the operator work-station.
- B. System Security
1. User access shall be secured using individual security passwords and user names.
  2. Passwords shall restrict the user to only the objects, applications, and system functions as assigned by the system manager.
  3. User logon/logoff attempts shall be recorded.
  4. The system shall protect itself from unauthorized use by automatically logging off following the last keystroke. The delay time shall be user definable.
- C. Scheduling. Provide the capability to schedule each object or group of objects in the system. Each of these schedules shall include the capability for start, stop, optimal start, optimal stop, and night economizer actions. Each schedule may consist of up to 10 events. When a group of objects are scheduled together, provide the capability to define advances and delays for each member. Each schedule shall consist of the following:
1. Weekly Schedule. Provide separate schedules for each day of the week.
  2. Exception Schedules. Provide the ability for the operator to designate any day of the year as an exception schedule. This exception schedule shall override the standard schedule for that day. Exception schedules may be defined up to a year

in advance. Once an exception schedule is executed it will be discarded and replaced by the standard schedule for that day of the week.

3. Holiday Schedules. Provide the capability for the operator to define up to 99 special or holiday schedules. These schedules may be placed on the scheduling calendar and will be repeated each year. The operator shall be able to define the length of each holiday period.
  4. Optimal Start/Stop. The scheduling application outlined above shall support an optimal start/stop algorithm. This shall calculate the thermal characteristics of a zone and start the equipment prior to occupancy to achieve the desired space temperature at the specified occupancy time. The algorithm shall calculate separate sets of heating and cooling rates for zones that have been unoccupied for less than and greater than 24 hours. Provide the ability to modify the start/stop algorithm based on outdoor air temperature. Provide an early start limit in minutes to prevent the system from starting before an operator determined time limit.
- E. Alarm Reporting. The operator shall be able to determine the action to be taken in the event of an alarm. Alarms shall be routed to the appropriate workstations based on time and other conditions. An alarm shall be able to start programs, be logged in the event log, printed, generate custom messages graphics.
- F. Remote Communications. The system shall have the ability to dial out in the event of an alarm. Receivers shall include PC Workstations, and Alphanumeric pagers. The alarm message shall include the name of the calling location, the device that generated the alarm, and the alarm message itself. The operator shall be able to remotely access and operate the system using dial up communications in the same format and method used on site under section 2.1 (Operator Interface).
- G. Demand Limiting.
1. The demand limiting program shall monitor building power consumption from signals generated by a pulse generator (provided by others) mounted at the building power meter, or from a watt transducer or current transformer attached to the building feeder lines.
  2. The demand limiting program shall be based on a predictive sliding window algorithm. The sliding window duration and sampling interval shall be set equal to that of the local Electrical Utility.
  3. Control system shall be capable of demand limiting by resetting HVAC system set-points to reduce load while maintaining Indoor Air Quality (humidity, VOC, CO2) and comfort control in the space.
  4. Input capability shall also be provided for an end-of-billing period indication.
- H. Maintenance Management. The system shall monitor equipment status and generate maintenance messages based upon user designated run time, starts, and/or calendar date limits.

- I. Chiller Sequencing: Provide applications software to properly sequence the chiller plant to minimize energy use. This application shall perform the following functions:
  1. The chiller plant control application shall have the ability to control a maximum of 25 chillers of any type including centrifugal, helirotor, scroll, reciprocating and absorption machines as detailed in the sequence of operations.
  2. This application shall be able to control both constant and variable flow systems as well as parallel, series and decoupled piping configurations.
  3. The chiller plant control application shall be able to control multiple chiller plants per site.
  4. Diagnostics/Protection- The chiller plant application program shall be able to integrate individual chiller diagnostics into control action decisions.
  5. Event Processing- All chiller plant control and status events shall be recorded, at the operator's selection, in the building management system event log to facilitate troubleshooting.
  6. Alarm Indications - The chiller plant control status screens shall display chiller plant and individual chiller alarm messages.
- J. PID Control. A PID (proportional-integral-derivative) algorithm with direct or reverse action and anti-wind-up shall be supplied. The algorithm shall calculate a time-varying analog value used to position an output or stage a series of outputs. The controlled variable, set-point, and PID gains shall be user-selectable. The set-point shall optionally be chosen to be a reset schedule.
- K. Staggered Start. This application shall prevent all controlled equipment from simultaneously restarting after a power outage. The order in which equipment (or groups of equipment) is started, along with the time delay between starts shall be user-selectable.
- L. System Calculations. Provide software to allow instantaneous power (e.g. KW), flow rates (e.g. L/s [GPM]) to be accumulated and converted to energy usage data. Provide an algorithm that calculates a sliding window KW demand value. Provide an algorithm that calculates energy usage and weather data (heating and cooling degree days). These items shall all be available for daily, previous day, monthly and the previous month.
- M. Anti-Short Cycling. All binary output points shall be protected from short cycling. This feature shall allow minimum on-time and off-time to be selected.

## 2.05 BUILDING CONTROLLERS

- A. General. Provide Building Controllers to provide the performance specified in section 1 of this division. Each of these panels shall meet the following requirements.
  1. The Building Automation System shall be composed of one or more independent, stand-alone, microprocessor based Building Controllers to manage the global strategies described in System software section.

2. The Building Controller shall have sufficient memory to support its operating system, database, and programming requirements.
  3. The controller shall provide a communications port for connection of the Portable Operators Terminal using Point to Point BACnet physical/data link layer protocol or a connection to the internetwork.
  4. The operating system of the Controller shall manage the input and output communications signals to allow distributed controllers to share real and virtual point information and allow central monitoring and alarms.
  5. Controllers that perform scheduling shall have a real time clock.
  6. Data shall be shared between networked Building Controllers.
  7. The Building Controller shall continually check the status of its processor and memory circuits. If an abnormal operation is detected, the controller shall:
    - a. Assume a predetermined failure mode.
    - b. Generate an alarm notification.
  8. BACnet. The Building Controller shall use the Read (Initiate) and Write (Execute) Services as defined in Clauses 15.5 and 15.8, respectively, of ASHRAE Standard 135-95, to communicate with BACnet objects in the internetwork. Objects supported shall include: Analog input, analog output, binary input, binary output, device.
- B. Communications. Each Building Controller shall reside on a BACnet internetwork using the ISO 8802-3 (Ethernet) or ARCNET (ASTM 878.1) Physical/Data Link layer protocol. Each Building Controller shall also perform routing to a network of Custom Application and Application Specific Controllers.
- C. Environment. Controller hardware shall be suitable for the anticipated ambient conditions. Controller used in conditioned ambient shall be mounted in an enclosure, and shall be rated for operation at 0 C to 50 C (32 F to 120 F).
- D. Serviceability. Provide diagnostic LEDs for power, communications, and processor. All wiring connections shall be made to field removable, modular terminal strips or to a termination card connected by a ribbon cable.
- E. Memory. The Building Controller shall maintain all BIOS and programming information in the event of a power loss for at least 72 hours.
- F. Immunity to power and noise. Controller shall be able to operate at 90% to 110% of nominal voltage rating and shall perform an orderly shutdown below 80% nominal voltage.

## 2.06 CUSTOM APPLICATION CONTROLLERS

- A. General. Provide Custom Application Controllers to provide the performance specified in section 1 of this division. Each of these panels shall meet the following requirements.
1. The Building Automation System shall be composed of one or more independent, stand-alone, microprocessor based Building Controllers to manage the local strategies described in System software section.
  2. The Controller shall have sufficient memory to support its operating system, database, and programming requirements.
  3. Controllers that perform scheduling shall have a real time clock.
  4. The operating system of the Controller shall manage the input and output communications signals to allow distributed controllers to share real and virtual point information and allow central monitoring and alarms.
  5. Data shall be shared between networked Controllers.
  6. The Controller shall continually check the status of its processor and memory circuits. If an abnormal operation is detected, the controller shall:
    - a. Assume a predetermined failure mode.
    - b. Generate an alarm notification.
- B. Environment. Controller hardware shall be suitable for the anticipated ambient conditions.
1. Controllers used outdoors and/or in wet ambient shall be mounted within NEMA 4 Type waterproof enclosures, and shall be rated for operation at -40 C to 65 C (-40 F to 150 F).
  2. Controller used in conditioned ambient shall be mounted in NEMA 1 Type rated enclosures, and shall be rated for operation at 0 C to 50 C (32 F to 120 F).
- C. Keypad. A local keypad and display shall be provided where specified in the sequence of operations or points list. Keypad shall be provided for interrogating and editing data. An optional system security password shall be available to prevent unauthorized use of the keypad and display.
- D. Serviceability. Provide diagnostic LEDs for power, communications, and processor. All wiring connections shall be made to field removable, modular terminal strips or to a termination card connected by a ribbon cable.
- E. Memory. The Controller shall maintain all BIOS and programming information in the event of a power loss for at least 72 hours.
- F. Immunity to power and noise. Controller shall be able to operate at 90% to 110% of nominal voltage rating and shall perform an orderly shutdown below 80% nominal voltage.

## 2.07 APPLICATION SPECIFIC CONTROLLERS

- A. General. Application specific controllers (ASC) are microprocessor based DDC controllers which through hardware or firmware design are dedicated to control a specific piece of equipment. They are not fully user programmable, but are customized for operation within the confines of the equipment they are designed to serve.
  - 1. Each ASC shall be capable of stand-alone operation and shall continue to provide control functions without being connected to the network.
  - 2. Each ASC will contain sufficient I/O capacity to control the target system.
- B. Environment. The hardware shall be suitable for the anticipated ambient conditions.
  - 1. Controllers used outdoors and/or in wet ambient shall be mounted within NEMA 4 Type waterproof enclosures, and shall be rated for operation at -40 C to 65 C (-40 F to 150 F).
  - 2. Controller used in conditioned ambient shall be mounted in NEMA 1 Type rated enclosures, and shall be rated for operation at 0 C to 50 C (32 F to 120 F).
- C. Serviceability. Provide diagnostic LEDs for power, and communications. All wiring connections shall be made to field removable modular terminal strips or to a termination card connected by a ribbon cable.
- D. Memory. The Application Specific Controller shall maintain all BIOS and programming information in the event of a power loss for at least 90 days.
- E. Immunity to Power and noise. Controller shall be able to operate at 90% to 110% of nominal voltage rating and shall perform an orderly shutdown below 80%.
- F. Transformer. Power supply for the ASC must be rated at minimum of 125% of ASC power consumption, and shall be fused or current limiting type.

## 2.08 COMMUNICATIONS

- A. This project shall comprise a BACnet inter-network. All PC Workstations and Building Controller components shall meet ASHRAE / ANSI Standard 135/1995, BACnet.
- B. Each BACnet device shall operate on the BACnet physical/data link protocols specified for that device as defined earlier in this section
- C. The controls Contractor shall provide all communication media, connectors, repeaters, hubs, and routers necessary for the inter-network.
- D. All Building Controllers shall have a communications port for connections with the operator interfaces. This may be either an RS-232 port for Point to Point connection or a network interface node for connection to the Ethernet or ARCNET network.

- E. Remote operator interface via a 56.6 Kb or faster baud modem shall allow for communication with any and all controllers on this network as described in F below.
- F. Communications services over the internetwork shall result in operator interface and value passing that is transparent to the internetwork architecture as follows:
  - 1. Connection of an operator interface device to any one controller on the internetwork will allow the operator to interface with all other controllers as if that interface were directly connected to the other controllers. Data, status information, reports, system software, custom programs, etc., for all controllers shall be available for viewing and editing from any one controller on the internetwork.
  - 2. All database values (i.e., points, software variable, custom program variables) of any one controller shall be readable by any other controller on the internetwork. This value passing shall be automatically performed by a controller when a reference to a point name not located in that controller is entered into the controller's database. An operator/installer shall not be required to set up any communications services to perform internetwork value passing.
- G. The time clocks in all controllers shall be automatically synchronized daily.

## 2.09 INPUT/OUTPUT INTERFACE

- A. Hard-wired inputs and outputs may tie into the system through Building, Custom, or Application Specific Controllers.
- B. All input points and output points shall be protected such that shorting of the point to itself, another point, or ground will cause no damage to the controller. All input and output points shall be protected from voltage up to 24V of any duration, such that contact with this voltage will cause no damage to the controller.
- C. Binary inputs shall allow the monitoring of on/off signals from remote devices. The binary inputs shall provide a wetting current of at least 12 ma to be compatible with commonly available control devices.
- D. Pulse accumulation input points. This type of point shall conform to all the requirements of Binary Input points, and also accept up to 2 pulses per second for pulse accumulation, and shall be protected against effects of contact bounce and noise.
- E. Analog inputs shall allow the monitoring of low voltage (0-10 Vdc), current (4-20 ma), or resistance signals (thermistor, RTD). Analog inputs shall be compatible with, and field configurable to commonly available sensing devices.
- F. Binary outputs shall provide for on/off operation, or a pulsed low voltage signal for pulse width modulation control. Binary outputs on custom and building controllers shall have 3-position (on/off/auto) override switches and status lights. Outputs shall be selectable for either normally open or normally closed operation.
- G. Analog outputs shall provide a modulating signal for the control of end devices. Outputs shall provide either a 0-10 Vdc or a 4-20 ma signal as required to provide proper control

of the output device. Analog outputs on building or custom programmable controllers shall have status lights and a 2-position (auto/manual) switch and manually adjustable potentiometer for manual override.

## 2.10 AUXILIARY CONTROL DEVICES

A Motorized dampers, unless otherwise specified elsewhere, shall be as follows:

1. Damper frames shall be 16 gauge galvanized sheet metal or 1/8" extruded aluminum with reinforced corner bracing.
2. Damper blades shall not exceed 8" in width or 48" in length. Blades are to be suitable for medium velocity performance (2,000 fpm). Blades shall be not less than 16 gauge.
3. Damper shaft bearings shall be as recommended by manufacturer for application.
4. All blade edges and top and bottom of the frame shall be provided with compressible seals. Side seals shall be compressible stainless steel. The blade seals shall provide for a maximum leakage rate of 10 CFM per square foot at 2.5" w.c. differential pressure.
5. All leakage testing and pressure ratings will be based on AMCA Publication 500.
6. Individual damper sections shall not be larger than 48" x 60". Provide a minimum of one damper actuator per section.

B. Control dampers shall be parallel or opposed blade type.

C. Electronic damper/valve actuators.

- 1 The actuator shall have electronic overload or digital rotation sensing circuitry to prevent damage to the actuator throughout the rotation of the actuator.
2. Where shown, for power-failure/safety applications, an internal mechanical, spring return mechanism shall be built into the actuator housing.
3. All rotary spring return actuators shall be capable of both clockwise or counter clockwise spring return operation. Linear actuators shall spring return to the retracted position.
4. Proportional actuators shall accept a 0-10 VDC or 0-20 ma control signal and provide a 2-10 VDC or 4-20 ma operating range.
5. All 24 VAC/DC actuators shall operate on Class 2 wiring and shall not require more than 10 VA for AC or more than 8 W for DC applications. Actuators operating on 120 VAC or 230 VAC shall not required more than 11 VA.
- 6 All non-spring return actuators shall have an external manual gear release to allow manual positioning of the damper when the actuator is not powered. Spring return

actuators with more than 60 in-lb. torque capacity shall have a manual crank for this purpose.

7. All modulating actuators shall have an external, builtin switch to allow the reversing of direction of rotation
8. Actuators shall be provided with a conduit fitting and a minimum 1m electrical cable and shall be pre-wired to eliminate the necessity of opening the actuator housing to make electrical connections.
9. Actuators shall be Underwriters Laboratories Standard 873 listed.
10. Actuators shall be designed for a minimum of 60,000 full stroke cycles at the actuator's rated torque.

D. Control Valves

1. Control valves shall be two-way or three-way type for two-position or modulating service as scheduled or shown.
2. Close-off (differential) Pressure Rating: Valve actuator and trim shall be furnished to provide the following minimum close-off pressure ratings:
  - a. Water Valves:
    - i. Two-way: 150% of total system (pump) head.
    - ii. Three-way: 300% of pressure differential between ports A and B at design flow or 100% of total system (pump) head.
  - b. Steam Valves: 150% of operating (inlet) pressure.
3. Water Valves:
  - a. Body and trim style and materials shall be per manufacturer's recommendations for design conditions and service shown, with equal percentage ports for modulating service.
  - b. Sizing Criteria:
    - i. Two-position service: Linesize.
    - ii. Two-way modulating service: Pressure drop shall be equal to twice the pressure drop through heat exchanger (load), 50% of the pressure difference between supply and return mains, or 3 psi, whichever is greater.
    - iii. Three-way Modulating Service: Pressure drop equal to twice the pressure drop through the coil exchanger (load), 5 psi maximum.
    - iv. Valves 1/2" through 2" shall be bronze body or cast brass ANSI Class 250, spring loaded, Teflon packing, quick opening for two position service. Two-way valves to have replaceable composition disc, or stainless steel ball.
    - v. 2-1/2" valves and larger shall be cast iron ANSI Class 125 with guided plug and Teflon packing.

- c. Water valves shall fail normally open or closed as scheduled on plans or as follows:
  - i. Heating coils in air handlers- normally open.  
(all other heating control valves– normally closed)
  - ii. Chilled water control valves- normally closed.
  - iii. Other applications - as scheduled or as required by sequence of operation.
- d. Zone valves shall be sized to meet the control application and they shall maintain their last position in the event of a power failure.

4. Steam Valves:

- a. Body and trim materials shall be per manufacturer's recommendations for design conditions and service. Linear ports for modulating service.
- b. Sizing Criteria:
  - i. Two-position service: pressure drop 10% to 20% of inlet psig.
  - ii. Modulating service 15 psig or less: pressure drop 80% of inlet psig.
  - iii. Modulating service 16 to 50 psig: pressure drop 50% of inlet psig.
  - iv. Modulating service over 50 psig: pressure drop as scheduled on plans.

E. TEMPERATURE SENSORS

- 1. Temperature sensors shall be Resistance Temperature Device (RTD) or Thermistor.
- 2. Duct sensors shall be rigid or averaging as shown. Averaging sensors shall be a minimum of 1.5m [5 feet] in length.
- 3. Immersion sensors shall be provided with a separable stainless steel well. Pressure rating of well is to be consistent with the system pressure in which it is to be installed.
- 4. Space sensors shall be equipped with setpoint adjustment, override switch, display, and/or communication port as shown on the drawings.
- 5. Provide matched temperature sensors for differential temperature measurement. Differential accuracy shall be within 0.1 C (0.2 F).

F. HUMIDITY SENSORS

- 1. Duct and room sensors shall have a sensing range of 20% to 80% with accuracy of  $\pm 5\%$  R.H.

2. Duct sensors shall be provided with a sampling chamber.
3. Outdoor air humidity sensors shall have a sensing range of 20% to 95% R.H. It shall be suitable for ambient conditions of -40 C to 75 C (-40 F to 170 F).
4. Humidity sensor's drift shall not exceed 1% of full scale per year.

G. STATIC PRESSURE SENSORS

1. Sensor shall have linear output signal. Zero and span shall be field adjustable.
2. Sensor sensing elements shall withstand continuous operating conditions plus or minus 50% greater than calibrated span without damage.
3. Water pressure sensor shall have stainless steel diaphragm construction, proof pressure of 150 psi minimum. Sensor shall be complete with 4-20 ma output, required mounting brackets, and block and bleed valves. Mount in location accessible for service.
4. Water differential pressure sensor shall have stainless steel diaphragm construction, proof pressure of 150 psi minimum. Overrange limit (DP) and maximum static pressure shall be 3,000 psi. Transmitter shall be complete with 4-20 ma output, required mounting brackets, and five valve manifold. Mount in a location accessible for service.

H. LOW LIMIT THERMOSTATS

1. Safety low limit thermostats shall be vapor pressure type with an element 6m (20 ft) minimum length. Element shall respond to the lowest temperature sensed by any one foot section.
2. Low limit shall be manual reset only.

I. INDOOR AIR QUALITY SENSORS

1. Indoor air quality sensors shall measure both total percentage VOCs and CO2 in PPM. Sensors shall be duct or space mounted.

J. FLOW SWITCHES

1. Flow-proving switches shall be either paddle or differential pressure type, as shown.
2. Paddle type switches (water service only) shall be UL listed, SPDT snapacting with pilot duty rating (125 VA minimum). Adjustable sensitivity with NEMA 1 Type enclosure unless otherwise specified:
3. Differential pressure type switches (air or water service) shall be UL listed, SPDT snap-acting, pilot duty rated (125 VA minimum), NEMA 1 Type enclosure, with scale range and differential suitable for intended application, or as specified.
4. Current sensing relays may be used for flow sensing or terminal devices.

K. RELAYS

1. Control relays shall be UL listed plugin type with dust cover. Contact rating, configuration, and coil voltage suitable for application.
2. Time delay relays shall be UL listed solidstate plug-in type with adjustabletime delay. Delay shall be adjustable plus or minus 200% (minimum) from setpoint shown on plans. Contact rating, configuration, and coil voltage suitable for application. Provide NEMA 1 Type enclosure when not installed in local control panel.

#### L. TRANSFORMERS and POWER SUPPLIES

1. Control transformers shall be UL listed, Class 2 currentlimiting type, or shall be furnished with overcurrent protection in both primary and secondary circuits for Class 2 service.
2. Unit output shall match the required output current and voltage requirements. Current output shall allow for a 50% safety factor. Output ripple shall be 3.0 mV maximum Peak-to-Peak. Regulation shall be 0.10% line and load combined, with 50 microsecond response time for 50% load changes. Unit shall have builtin over-voltage protection.
3. Unit shall operate between 0 C and 50 C.
4. Unit shall be UL recognized.

#### M. CURRENT SWITCHES

1. Current-operated switches shall be selfpowered, solid state with adjustable trip current. The switches shall be selected to match the current of the application and output requirements of the DDC system.

#### N. LOCAL CONTROL PANELS

1. All indoor control cabinets shall be fully enclosed NEMA 1 Type construction with (hinged door), keylock latch, removable sub-panels. A single key shall be common to all field panels and subpanels.
2. Interconnections between internal and facemounted devices prewired with color-coded stranded conductors neatly installed in plastic troughs and/or tiwrapped. Terminals for field connections shall be UL listed for 600volt service, individually identified per control/interlock drawings, with adequate clearance for field wiring. Control termination's for field connection shall be individually identified per control drawings.
3. Provide on/off power switch with overcurrent protection and main air gauge for control power sources to each local panel.

3.01 SECTION INCLUDES:

- A. Examination
- B. General Workmanship
- C. Wiring
- D. Fiber Optic Cable
- E. Installation of Sensors
- F. Flow Switch Installation
- G. Actuators
- H. Warning Labels
- I. Identification of Hardware and Wiring
- J. Controllers
- K. Programming
- L. Cleaning
- M. Protection
- N. Training
- O. Field Quality Control
- P. Check-out, Start-up, and Testing
- Q. Acceptance

3.02 EXAMINATION

- A. The project plans shall be thoroughly examined for control device and equipment locations, and any discrepancies, conflicts, or omissions shall be reported to the Architect/Engineer for resolution before rough-in work is started.
- B. The contractor shall inspect the site to verify that equipment is installable as shown, and any discrepancies, conflicts, or omissions shall be reported to the Architect/Engineer for resolution before rough-in work is started.

3.03 GENERAL WORKMANSHIP

- A. Install equipment, piping, wiring/conduit parallel to building lines (i.e. horizontal, vertical, and parallel to walls) wherever possible.
- B. Provide sufficient slack and flexible connections to allow for vibration of piping and equipment.
- C. Install all equipment in readily accessible location as defined by chapter 1 article 100 part A of the NEC. Control panels shall be attached to structural walls unless mounted in equipment enclosure specifically designed for that purpose. Panels shall be mounted to allow for unobstructed access for service.
- D. Verify integrity of all wiring to ensure continuity and freedom from shorts and grounds.
- E. All equipment, installation, and wiring shall comply with acceptable industry specifications and standards for performance, reliability, and compatibility and be executed in strict adherence to local codes and standard practices.

3.04 WIRING

- A. All control and interlock wiring shall comply with the national and local electrical codes and Sections 1600's of these specifications. Where the requirements of this section differ with those in Section 1600's, the requirements of this section shall take precedence.
- B. Where Class 2 wires are in concealed and accessible locations including ceiling return air plenums, approved cables not in raceway may be used provided that:
  - 1. Circuits meet NEC Class 2 (current-limited) requirements. (Low voltage power circuits shall be sub-fused when required to meet Class 2 current limit.)
  - 2. All cables shall be UL listed for application, i.e. cables used in ceiling plenums shall be UL listed specifically for that purpose.
- C. Do not install Class 2 wiring in conduit containing Class 1 wiring. Boxes and panels containing high voltage may not be used for low voltage wiring except for the purpose of interfacing the two (e.g. relays and transformers).
- D. Where class 2 wiring is run exposed, wiring shall be run parallel along a surface or perpendicular to it, and bundled, using approved wire ties at no greater than 3 m [10 ft] intervals. Such bundled cable shall be fastened to the structure, using specified fasteners, at 1.5 m [5 ft] intervals or more often to achieve a neat and workmanlike result.
- E. All wire-to-device connections shall be made at a terminal blocks or terminal strip. All wire-to-wire connections shall be at a terminal block, or with a crimped connector. All wiring within enclosures shall be neatly bundled and anchored to permit access and prevent restriction to devices and terminals.
- F. Maximum allowable voltage for control wiring shall be 120V. If only higher voltages are available, the Control System Contractor shall provide step down transformers.
- G. All wiring shall be installed as continuous lengths, where possible. Any required splices shall be made only within an approved junction box or other approved protective device.
- H. Install plenum wiring in sleeves where it passes through walls and floors. Maintain fire rating at all penetrations in accordance with other sections of this specification and local codes.
- I. Size of conduit and size and type of wire shall be the design responsibility of the Control System Contractor, in keeping with the manufacturer's recommendation and NEC.
- J. Control and status relays are to be located in designated enclosures only. These relays may also be located within packaged equipment control panel enclosures. These relays shall not be located within Class 1 starter enclosures.
- K. Follow manufacturer's installation recommendations for all communication and network cabling. Network or communication cabling shall be run separately from other wiring.
- L. Adhere to Section 1600's requirements for installation of raceway.
- M. This Contractor shall terminate all control and/or interlock wiring and shall maintain updated (as-built) wiring diagrams with terminations identified at the job site.

- N. Flexible metal conduits and liquidtight, flexible metal conduits shall not exceed 3' in length and shall be supported at each end. Flexible metal conduit less than 1/2" electrical trade size shall not be used. In areas exposed to moisture, including chiller and boiler rooms, liquid-tight, flexible metal conduits shall be used.

### 3.05 FIBER OPTIC CABLE SYSTEM

- A. All cabling shall be installed in a neat and workmanlike manner. Minimum cable and unjacketed fiber bend radii as specified by cable manufacturer shall be maintained.
- B. Maximum pulling tensions as specified by the cable manufacturer shall not be exceeded during installation. Post installation residual cable tension shall be within cable manufacture's specifications.
- C. Fiber optic cabinets, hardware, and cable entering the cabinet shall be installed in accordance with manufacturers' instructions. Minimum cable and unjacketed fiber bend radii as specified by cable manufacturer shall be maintained.

### 3.06 INSTALLATION OF SENSORS

- A. Install sensors in accordance with the manufacturer's recommendations.
- B. Mount sensors rigidly and adequate for the environment within which the sensor operates.
- C. Room temperature sensors shall be installed on concealed junction boxes properly supported by the wall framing.
- D. All wires attached to sensors shall be air sealed in their conduits or in the wall to stop air transmitted from other areas affecting sensor readings.
- E. Install duct static pressure tap with tube end facing directly downstream of air flow.
- F. Sensors used in mixing plenums, and hot and cold decks shall be of the averaging type. Averaging sensors shall be installed in a serpentine manner horizontally across duct. Each bend shall be supported with a capillary clip.
- G. All pipe mounted temperature sensors shall be installed in wells. Install all liquid temperature sensors with heat conducting fluid in thermal wells.
- H. Wiring for space sensors shall be concealed in building walls. EMT conduit is acceptable within mechanical and service rooms.
- I. Install outdoor air temperature sensors on north wall complete with sun shield at designated location.

### 3.07 FLOW SWITCH INSTALLATION

- A. Install using a thread-o-let in steel pipe. In copper pipe use C x C x F Tee, no pipe extensions or substitutions allowed.

- B. Mount a minimum of 5 pipe diameters up stream and 5 pipe diameters downstream or 2 feet which ever is greater, from fittings and other obstructions.
- C. Install in accordance with manufacturers instructions.
- D. Assure correct flow direction and alignment.
- E. Mount in horizontal piping- flow switch on top of the pipe.

### 3.08 ACTUATORS

- A. Mount and link control damper actuators per manufacturer's instructions.
- B. To compress seals when spring return actuators are used on normally closed dampers, power actuator to approximately 5° open position, manually close the damper, and then tighten the linkage.
- C. Check operation of damper/actuator combination to confirm that actuator modulates damper smoothly throughout stroke to both open and closed positions.
- D. Valves - Actuators shall be mounted on valves with adapters approved by the actuator manufacturer. Actuators and adapters shall be mounted following manufacturer's recommendations.

### 3.09 WARNING LABELS

- A. Affix plastic labels on each starter and equipment automatically controlled through the Control System. Label shall indicate the following:

#### C A U T I O N

This equipment is operating under automatic control and may start at any time without warning.

### 3.10 IDENTIFICATION OF HARDWARE AND WIRING

- A. All wiring and cabling, including that within factory fabricated panels, shall be labeled at each end within 2" of termination with a cable identifier and other descriptive information.
- B. Permanently label or code each point of field terminal strips to show the instrument or item served.
- C. Identify control panels with minimum 1 cm letters on laminated plastic nameplates.
- D. Identify all other control components with permanent labels. Identifiers shall match record documents. All plug-in components shall be labeled such that removal of the component does not remove the label.

### 3.11 CONTROLLERS

- A. Provide a separate Controller for each major piece of HVAC equipment. Points used for control loop reset such as outside air or space temperature are exempt from this requirement.
- B. Building Controllers and Custom Application Controllers shall be selected to provide a minimum of (15%) spare I/O point capacity for each point type found at each location. If input points are not universal, (15%) of each type is required. If outputs are not universal, (15%) of each type is required. A minimum of one spare is required for each type of point used.
- C. Future use of spare capacity shall require providing the field device, field wiring, point database definition, and custom software. No additional Controller boards or point modules shall be required to implement use of these spare points.

### 3.12 PROGRAMMING

- A. Provide sufficient internal memory for the specified control sequences and trend logging. There shall be a minimum of 25% of available memory free for future use.
- B. Point Naming: System point names shall be modular in design, allowing easy operator interface without the use of a written point index.
- C. Software Programming
  - 1. Provide programming for the system as per specifications and adhere to the strategy algorithms provided. All other system programming necessary for the operation of the system but not specified in this document shall also be provided by the Control System Contractor. Imbed into the control program sufficient comment statements to clearly describe each section of the program. The comment statements shall reflect the language used in the sequence of operations.
- D. Operators' Interface
  - 1. Standard Graphics. Provide graphics for each major piece of equipment and floor plan in the building. This includes each Chiller, Air Handler, VAV Terminal, Fan Coil, Boiler, and Cooling Tower. These standard graphics shall show all points dynamically as specified in the points list.
  - 2. The controls contractor shall provide all the labor necessary to install, initialize, start-up, and trouble-shoot all operator interface software and their functions as described in this section. This includes any operating system software, the operator interface data base, and any third party software installation and integration required for successful operation of the operator interface.
  - 3. As part of this execution phase, the controls contractor will perform a complete test of the operator interface. Test duration shall be a minimum of 16 hours on site. Tests shall be made in the presence of the Government.

- E. Demonstration: A complete demonstration and readout of the capabilities of the monitoring and control system shall be performed. The contractor shall dedicate a minimum of 16 hours onsite with the Owner and his representatives for a complete functional demonstration of all the system requirements. This demonstration constitutes a joint acceptance inspection, and permits acceptance of the delivered system for online operation.

### 3.13 CLEANING

- A. This contractor shall clean up all debris resulting from his or her activities daily. The contractor shall remove all cartons, containers, crates, etc. under his control as soon as their contents have been removed. Waste shall be collected and placed in a location designated by the COR or General Contractor.
- B. At the completion of work in any area, the Contractor shall clean all of his/her work, equipment, etc., making it free from dust, dirt and debris, etc.
- C. At the completion of work, all equipment furnished under this Section shall be checked for paint damage, and any factory finished paint that has been damaged shall be repaired to match the adjacent areas. Any metal cabinet or enclosure that has been deformed shall be replaced with new material and repainted to match the adjacent areas.

### 3.14 PROTECTION

- A. The Contractor shall protect all work and material from damage by his/her work or workers, and shall be liable for all damage thus caused.
- B. The Contractor shall be responsible for his/her work and equipment until finally inspected, tested, and accepted. The Contractor shall protect his/her work against theft or damage, and shall carefully store material and equipment received on site that is not immediately installed. The Contractor shall close all open ends of work with temporary covers or plugs during storage and construction to prevent entry of foreign objects.

### 3.15 TRAINING

- A. Provide a minimum of 5 classroom training sessions, 8 hours each, throughout the contract period for personnel designated by the Owner. Computer based training may be substituted for up to 24 hours of hands on training.
- B. Train the designated staff of Owner's representative and Owner to enable them to proficiently operate the system; create, modify and delete programming; add, remove and modify physical points for the system; add additional panels when required.
- C. These objectives will be divided into three logical groupings; participants may attend one or more of these, depending on level of knowledge required:
  - 1. Day-to-day Operators
  - 2. System Troubleshooter
  - 3. System Manager: parts

- D. Provide course outline and materials as per Part 1 of this Section. The instructor(s) shall provide one copy of training material per student.
- E. The instructor(s) shall be factory-trained instructors experienced in presenting this material.
- F. Classroom training shall be done using a network of working controllers representative of the installed hardware or at the customers site.

### 3.16 FIELD QUALITY CONTROL

- A. All work, materials and equipment shall comply with the rules and regulations of applicable local, state, and federal codes and ordinances as identified in Part 1 of this Section.
- B. Contractor shall continually monitor the field installation for code compliance and quality of workmanship. All visible piping and or wiring runs shall be installed parallel to building lines and properly supported.
- C. Contractor shall arrange for field inspections by local and/or state authorities having jurisdiction over the work.

### 3.17 ACCEPTANCE

- A. The control systems will not be accepted as meeting the requirements of Completion until all tests described in this specification have been performed to the satisfaction of the Government. Any tests that cannot be performed due to circumstances beyond the control of the Contractor may be exempt from the Completion requirements if stated as such in writing by the COR. Such tests shall then be performed as part of the warranty.

### 3.18 SEQUENCE OF OPERATIONS

- A. Sequence of operations for equipment will appear in Sections directly after this one. All Sections of sequence of operations will start as PART 4, and major equipment (ie: chillers, AHU, etc..) have been separated into individual separate Sections for ease of use.

\*\* END OF SECTION \*\*

## PART 4: SEQUENCE OF OPERATIONS

### 4.01 AIR COOLED HELICAL ROTARY CHILLERS SYSTEM CONTROLS

- A. General - The standalone microprocessor based chiller control panel shall monitor and control the chillers in a standalone mode or as directed by the chiller sequencing software.

The chiller sequencing software shall perform the following control strategies, provide the points as listed on the chiller point list and support their specified monitoring and diagnostics.

- B. System Scheduling- The chiller plant shall start in response to the optimum start, night setback or timed override operation of any system air handler.
- C. Chiller Sequencing- The chiller sequencing software will start and stop system water pumps and chillers based upon system load.

1. When the chilled water system is enabled the chiller system control will:

- a. Start the system chilled water pump.
- b. Start the lead chiller chilled water pump and prove flow through the evaporator
- c. Start the lead chiller after chilled water is proven.

### DECOUPLED CHILLER PLANT CONTROL

2. The chiller sequencing software shall consider starting another chiller whenever there is deficit flow in the primary- secondary decoupler (bypass) pipe.

The chiller sequencing software shall determine when there is deficit flow by measuring the system and chiller return water and decoupler water temperatures. Mixing equations shall then be used to calculate the deficit flow volume.

When deficit flow exists continuously for an operator specified length of time, the chiller sequencing software shall initiate the start of the next chiller in the sequence.

- a. Lag chiller shall start in a similar manner to the lead chiller start sequence.
- b. The chiller sequencing software will unload operating chiller prior to starting a lag chiller.
- c. The BAS shall control each chiller's setpoint to equalize the chiller unloading and meet system demand as the system load varies.

3. The chiller sequencing software shall consider stopping another chiller whenever the excess flow in the decoupler (bypass) pipe exceeds 120 percent of the next off chiller's flow.

The chiller sequencing software shall determine the quantity of excess flow by measuring the system and chiller supply and return water and decoupler water temperatures. Mixing equations shall then be used to calculate the deficit flow volume.

When the calculated excess flow exceeds 120 percent of the next off chiller's flow continuously for 12 minutes, the chiller sequencing software shall initiate the shutdown of the next chiller in the sequence. The excess flow setpoint and duration shall be easily modifiable by the chiller systems operator.

- a. The chiller sequencing software will not shutdown the chiller pump until it has confirmed that the chiller compressor has shutdown.
4. The chiller sequencing software shall control individual chiller setpoints to the system supply water temperature setpoint. The system setpoint shall be 7.22C (45F) degrees and editable by the operator. Chilled water reset shall not be used because of its affect on secondary chilled water pumping power.
5. Prior to the start of another chiller all operating chillers shall be unloaded. This is done to prevent flow disturbances caused by the starting of another pump from affecting chiller operation. Following confirmation of the additional chiller operation all chillers shall be allowed to reload.
6. The chiller sequencing software shall optimize operation of a heat recovery chiller by base loading that chiller. It shall be operated in a first on last off sequence while continuing to automatically rotate the sequence of other chillers.
7. The chiller sequencing software shall optimize operation of a system with a lower efficiency or backup chiller by peak loading that chiller. It shall be operated in a last on first off sequence while continuing to automatically rotate the sequence of other chillers.
8. This system does not have a swing chiller, so no swing chiller strategy is required.
9. Upon sensing a chiller failure the chiller sequencing software shall lockout that chiller and pump and immediately initiate the start of the next chiller in the rotation sequence.
10. Automatic rotation of chiller operation will equalize chiller run time.
  - a. Rotation shall be initiated based on an operator entered day interval or by the cycling of a binary point.
  - b. The method of sequence shall be operator selectable. Chillers maybe forced into a new rotation sequence by cycling chillers at the time of initiation.

Alternatively chiller cycling caused by normal system load fluctuations shall cause the chillers to change rotation sequence therefore eliminating unnecessarily chiller cycling.

- D. Chiller Soft Start - The chiller sequencing software will provide a user adjustable loading time at system start-up. This prevents the unnecessary operation of chillers and limits system electrical demand during chilled water loop pull down.
- E. Chilled Water Reset- Provide reset of the chilled water supply temperature setpoint based on return chilled water. The no reset design system water setpoint shall be 7.22C (45F)degrees with a reset rate of 0.56C (1F) degrees of reset in system supply water setpoint per 0.56C (1F) degree of drop in reset sensor temperature. The reset parameters shall be user select~~ab~~
- F. Chiller Demand Limiting- As part of the demandlimiting scheme on the building, the chiller sequencing software shall be able to monitor and reduce peak power demand through the limiting of chiller system capacity.
- G. Chiller Status Report - Provide an operating status report for each chiller. The report(s) shall provide the present status of all binary information and for analog information present value, today's average, and the month to date average for the following information to provide the operator with critical chiller operating data.
  - 1. Compressor On/Off Status.
  - 2. Compressor Starts/Run Hours- Compressor A, B
  - 3. Phase 1/2/3 Percent RLA- Compressor A, B
  - 4. Active Chiller Diagnostics or Alarms
  - 5. Leaving Chilled Water Temperature
  - 6. Entering Chilled Water Temperature
  - 7. Water Heater Entering/Leaving Temperatures
  - 8. Chilled Water Setpoint.
  - 9. Condenser Fan Percent Airflow- Circuit 1, 2
  - 10. Refrigerant Temperature Evaporator/Condenser- Circuit 1, 2
  - 11. Operating Mode
  - 12. Chiller Model and Serial Number
  - 13. Percent RLA/Percent Current Limit
  - 14. Outside Air Temperature
  - 15. Zone Temperature (optional)
- H. Diagnostics/Protection- the BAS system shall be able to alarm from all sensed points and diagnostic alarms sensed by the chiller controller.
  - 1. Alarm limits shall be designated for all sensed points.
- I. System diagnostic and alarm indication

1. The chiller plant control system shall display the chiller plant diagnostic and alarm status at the operator CRT and at the chiller plant control system panel display. The CRT diagnostic and alarm display shall include an English language description, indication as to whether the alarm is an individual chiller alarm or a chiller system alarm, and the time and date of the alarm.
  - a. Individual chiller and chiller plant system alarms shall be classified as either latching or non-latching. Both Latching and non latching alarms will shut down the chiller.
  - b. Latching chiller and chiller system alarms will cause an alarm message to be printed on the optional chiller plant control system printer, and will automatically log the alarm message in the battery backed up (minimum 72 hour back-up) software Event Log.
  - c. The chiller plant control system shall have an "audible alarm" feature which, when activated by the operator, will generate an audible tone at the CRT and initiate an autodial sequence via an autodial modem when a latching alarm occurs.
  - d. All latching alarms shall only be resettable at the Chiller control panel. The chiller plant control system shall automatically record a "return-to-normal" message in the software Event Log when a latching alarm is reset by the operator.
  - e. The chiller plant control system shall have a "print changes" and "Save changes" feature which, when activated by the operator, will cause messages for Non-Latching alarms to be printed or automatically logged in the software Event Log.
2. Individual chiller diagnostic and alarm statuses shall include the following latching items for each chiller:
  - a. Leaving Evaporator Sensor Failure
  - b. Entering Evaporator Sensor Failure
  - c. Low Chilled Water Temperature
  - d. Overload Trip - Compressor A, B, C, D
  - e. High Motor Temperature - Compressor A, B, C, D
  - f. Contactor Failure - Compressor A, B, C, D
  - g. High Oil Temperature - Compressor A, B, C, D
  - h. Oil Temperature Sensor Failure - Compressor A, B, C, D
  - i. Oil System Fault - Circuit 1, 2
  - j. Low Pressure Cutout - Circuit 1, 2
  - k. High Pressure Cutout - Circuit 1, 2
  - l. Solenoid Valve Failure - Circuit 1, 2
  - m. Phase Loss
  - n. External Interlock

o. Unit Controller

3. Individual chiller diagnostic and alarm statuses shall include the following non-latching items for each chiller:

- a. Entering Evaporator Sensor Failure
- b. Outdoor Air Temperature Sensor Failure
- c. Zone Temperature Sensor Failure
- d. High Voltage
- e. Low Voltage
- f. Phase Reversal
- g. Chiller Water Flow Interlock
- h. Unit Communication Loss
- i. Low Chilled Water Temperature (unit off)
- j. Circuit 1 - Pumpdown Timeout
- k. Circuit 2 - Pumpdown Timeout
- l. Condenser Fan Variable Speed DriveFault

\*\* END OF SEQUENCE SECTION \*\*

## SYSTEM POINT LIST (FOR CHILLER CH-1 & CH-2)

[illegible]

**GENERAL NOTES:**

1. Diagnostics include Compressor Phase Fail and Compressor Starter
2. Provide Optional Outdoor Air Temperature sensor.
3. 70 -125 Ton only

## SYSTEM POINT LIST (CHILLERS CH-1 & CH-2)

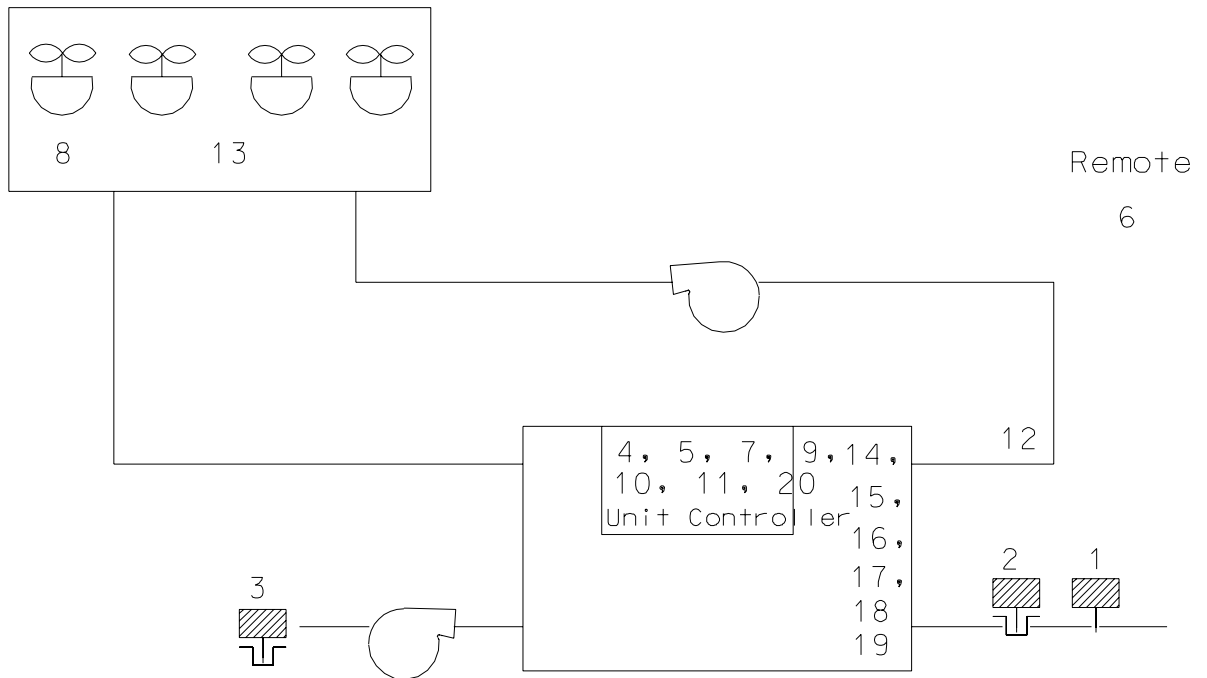
[illegible]

**GENERAL NOTES:**

4. Provide optional zone temperature sensor.

5. Secondary Pumps SCHWP-1 & SCHWP-2 (one Duty & one Standby)

# Air Cooled Helical Rotary Chiller with Unit Controller



1. Chilled water
2. Chilled water supply
3. Chilled water return
4. Current limit setpoint
5. Chilled water setpoint
6. Outside air temperature
7. Unit % RLA
8. Condenser air flow
9. % Units volts
10. Compressor starts/run hours
11. Compressor % RLA
12. Evaporator refrigerant temperature
13. Condenser refrigerant temperature
14. Chiller alarms
15. Electric fault
16. Phase fail
17. Compressor start
18. Oil flow
19. Entering oil temperature
20. Ice mode enable/disable

AI	A0	BI	B0
		X	
X			
X			
	X		
	X		
X			
X			
X			
X			
		X	
		X	
		X	
		X	
		X	
X			
			X

## PART 4: SEQUENCE OF OPERATIONS

### VAV AIR HANDLING UNIT(s) WITH STATIC PRESSURE OPTIMIZATION

#### General Design Intent and AHU features

- a. Variable Frequency Drive (VFD) for both Supply and Return Fans.
- b. IAQ capable, CO<sub>2</sub> Sensors to be located on each AHUs main Return Air Duct.
- c. Outdoor Air Demand Ventilation Reset based on CO<sub>2</sub> setpoint.
- d. Direct Building Pressure Control based on Differential Air Sensor setpoint (for bldg pressurization control).
- e. Supply Fan Pressure Optimization based on "Critical Zone Reset".
- f. AHU to be of Modular Configuration.
- g. AHU shall be of Exhaust Air Economizer Configuration.
- h. AHU shall have Low Ambient Temperature Control.

#### A. OCCUPIED COOLING MODE

When the AHU is in the Occupied Cooling Mode, the Supply Fan will operate continuously, the Frequency Inverter will modulate to maintain the Duct Static Pressure, and the Cooling Valve, Heating Valve, and Economizer Dampers will modulate in sequence to maintain Discharge Air Temperature.

#### B. UNOCCUPIED MODE

When the AHU is in the Unoccupied Mode, the Supply Fan will be OFF, the Frequency Inverter, Outdoor Air Damper, and Cooling Valve will be closed, and the Heating Valve will be closed.

#### C. NIGHT SETBACK / MORNING WARMUP HEATING MODE / MORNING PRE COOLING MODE

NIGHT SETBACK MODE – The AHU will be "OFF". (During Heating Cycle, room/zone temperature is maintained by fan cycling and heat coil valve cycling of VAV Terminal Boxes. During Cooling Cycle, room/zone temperature will not be maintained)

MORNING WARMUP HEATING MODE - When the AHU is in the Morning Warmup Heating Mode, the Supply Fan will operate continuously, the Frequency Inverter will modulate to maintain the Duct Static Pressure, the Outdoor Air Damper and Cooling Valve will be closed, the Return Air Damper will be fully open, and the Heating Valve will modulate to maintain the maximum heating Discharge Air Temperature setpoint. The unit shall signal all VAV Terminal Units to full flow until the Morning Warmup setpoint is reached and the AHU returns to occupied mode.

MORNING PRE-COOLING MODE - When the AHU is in the Morning PreCooling Mode, the Supply Fan will operate continuously, the Frequency Inverter will modulate to maintain the Duct Static Pressure, the Outdoor Air Damper and Cooling Valve will be closed, the Return Air Damper will be fully open, and the Cooling Valve will modulate to maintain the maximum Cooling Discharge Air Temperature setpoint. The unit shall signal all VAV Terminal Units to full flow until the Morning Cooling setpoint is reached and the AHU returns to occupied mode.

D. SUPPLY FAN CONTROL

The Supply Fan will operate continuously whenever the AHU is in either of the following: Occupied Cooling Mode, Occupied Heating Mode, Morning Warmup Heating Mode, or Morning Pre-Cooling Mode. The Supply Fan will be OFF whenever the AHU is in the Unoccupied Mode, the Stop/Auto interlock is open, the Mixed Air Low Limit is tripped, or the Supply Fan Status indicates a failure (after a two minute delay). The Low Limit and the Fan Failure require a manual reset.

E. FREQUENCY INVERTER CONTROL

When the Supply Fan is ON, the Frequency will slowly ramp (adjustable) up to setpoint and modulate to maintain the proper Duct Discharge Static Pressure. The Frequency Inverter will de-energize if the Supply Fan is OFF or the Duct Static Pressure Sensor fails.

F. ECONOMIZER CONTROL

When the Outdoor Air Temperature is less than the changeover setpoint, the Outdoor Air Damper will modulate between the adjustable minimum position and full open to maintain the Discharge Air Temperature at the Economizer Setpoint. A manual reset Mixed Air Low Limit will turn the Supply Fan OFF if any 12 inches of its sensing element is below its setpoint.

The Outdoor Air Damper will be set to its adjustable minimum position if the Economizer function is disabled. If the AHU is in either of the following: Morning Warmup mode, Morning Pre-Cooling mode, the Supply Fan is "OFF", or the Mixed Air Temperature Sensor has failed, the Outdoor Air Damper shall be closed.

G. HEATING VALVE CONTROL

The Heating Valve will modulate to maintain the Discharge Air Temperature at the Discharge Heating Setpoint (Adjustable, set @ 15.6°C 60°F). If the AHU is in the Heating mode, the unit will control the supply air temperature to Discharge Air at its Setpoint. The Heating Valve will be closed if the Outdoor Air Damper is open past its minimum position or if the Cooling Valve is open. The Heating Valve will be closed if the Supply Fan is "OFF".

H. COOLING VALVE CONTROL

The Cooling Valve shall modulate to maintain the Discharge Air Temperature at the Discharge Cooling Setpoint (Adjustable, set @ 15.8°C 60°F). If the Economizer function is enabled and the Outdoor Air Damper is fully opened, the Cooling Valve shall be closed. The Cooling Valve shall be closed if the AHU is in the Heating mode, the Supply Fan is OFF, or the Discharge Air Sensor has failed.

## I. BUILDING AUTOMATION SYSTEM INTERFACE

The Building Automation System (BAS) shall send the AHU a Discharge Air Cooling Setpoint, and a Duct Discharge Static Pressure Setpoint. The BAS shall also send Start-up, Occupied, Unoccupied, Morning Warmup, Morning Pre-Cooling, Heating / Cooling, Economizer enable, Timed Override, Startup, Coastdown, Demand Limit, Day Cycle, Night Setback (AHU shall be "OFF", zone/room temperature maintained through re-heat coil valve and fan cycling at VAV Boxes), Purge, CO2 level setpoint, AHU system Direct Building Pressurization level setpoint, and Priority Shutdown commands.

If communication with the BAS is lost, the AHU uses its default setpoints and operates in the Occupied Cooling mode. The Economizer function is enabled based on the AHU Outdoor Air Temperature Sensor (Comparison of Outdoor Air Temperature versus Return Air Temperature).

### AHU SYSTEM LEVEL CONTROL

#### 1. Static Pressure Optimization of Discharge Air Temperature and Static Pressure Setpoints

The building automation system shall monitor the damper position of all VAV terminal units and determine each VAV AHU's critical zone VAV terminal (CZ), which is the VAV terminal unit that is the widest open.

When the CZ is more than 95% open but less than 97% open (between 95% thru 97%), the supply fan discharge static pressure setpoint shall be reset downward by 10% of the previous setpoint at a frequency of 10 minutes until the CZ is more than 97% open or the static pressure setpoint has reset downward to the system minimum setting, or Frequency Inverter are at their minimum setting.

When the CZ is less than 95% open and the supply fan discharge static pressure setpoint is at the minimum setting, the discharge air temperature setpoint shall be reset upward in increments of 0.5 F at a frequency of 10 minutes and the static pressure setpoint held constant until the CZ is more than 97% open or the discharge air temperature is reset to its maximum setting of 4.2°C (8°F) above design setting.

The reverse control sequencing shall occur when the CZ is above 98% open until the discharge air temperature setpoint and the static pressure setpoint are at their design setpoints.

The control bands, setpoint increment values, setpoint decrement values and adjustment frequencies shall be adjusted to maintain maximum static pressure optimization with stable system control and maximum comfort control.

2. VAV Box Reheat Interlock Control

Each VAV box reheat shall be disabled from, or enabled for local control by the VAV box standalone controller.

At a minimum, all boxes being served by an AHU shall be controlled as a group. Provide more groups as designated in the points list, drawings or elsewhere in this specification. (VAV Terminals shall be grouped per AHU per floor)

The interlock shall be controlled by comparing the outside air ambient temperature to the interlock setpoint (adjustable) set at 15.6°C (60°F). If each AHU controller is individually sensing the outside air ambient temperature serving the unit, then the temperature sensor for that AHU shall be used for the interlock for its group of boxes.

The interlock shall also be controlled by a system operator command and other processes.

5. AHU Indoor Air Quality (IAQ): Carbon Dioxide Monitoring and Control (Active/Dynamic Ventilation Reset)

A Carbon Dioxide Sensor shall be installed in the Return Air Stream of each AHU, which will monitor the level of CO<sub>2</sub> of the Return Air. Based on the operator setpoint of the CO<sub>2</sub> level (set @ 800ppm), which the system is to maintain, the AHU's shall modulate Outdoor Air Damper and the Return Air Damper to provide the correct proportion/mixture of Outdoor and Return Air to maintain the AHU's CO<sub>2</sub> level setpoint.

The AHU shall have prescribed minimum level Outdoor Air Level set points (lower limit ventilation stops) for quantity of Outdoor Air which shall be as shown in the Contract Drawings. Outdoor Air Quantity shall not be any less than the setpoint minimum lock-out quantity.

6. Direct Building Positive Pressure Control:

Each AHU shall be installed with a Direct Building Pressure Control Sensor. The Sensor shall monitor and control building pressure relative outdoor ambient pressure. The building pressure setpoint shall be operator adjustable.

The Direct Building Pressure Sensor Control shall enable the AHU's Return Fan to either increase or decrease its speed. The increase or decrease in speed shall in effect control the quantity of Air to be exhausted from the building, and thereby controlling the building's air pressure directly. This controlling process shall be direct (as opposed to indirect) since the building pressure level is taken directly from locations inside the building. See Contract Plans for locations of Building Air Pressure Sensors.

Preset building pressure setpoint at  
25 Pa (0.1" wg)

J. The following points will be monitored and alarmed at the AHU controller and the BAS:

1. Supply air temp-Damper/Fan Speed output %
2. Mixed air temp-Heat output %
3. Outside air temp-Cool output %
4. Space temp-Fan modulation %
5. Duct static pressure-Low limit status
6. Fan status-Heat/cool mode
7. Sensors Norm/Fail status-DDC loop parameters
5. Filter Norm/Dirty-Damper Min. Pos. %
6. Carbon Dioxide (CO<sub>2</sub>) level-Return Air Stream
7. Outside Air Damper Position Relative to CQ Level for (IAQ)
8. Return Fan/Speed Output %
9. Direct Building Air Pressure level/Sensor

K. The following points will be operator adjustable and/or automatically reset by a BAS program.

1. Heating setpoint-Heat reset setpoint
2. Cooling setpoint-Cool reset setpoint
3. Economizer setpoint-OA changeover
4. Min. Position setpoint-Static press. setpoint
5. Damper open/close-Cool/Heat disable
6. Carbon Dioxide (CO<sub>2</sub>) Setpoint
7. Outdoor Air Damper position setpoint (Active/Ventilation Reset for IAQ)
8. Direct Building Pressure Level setpoint

\*\* END OF SEQUENCE SECTION \*\*

## SYSTEM POINT LIST (FOR AHU-1, AHU-2, AHU-3 & AHU-4)

[illegible]

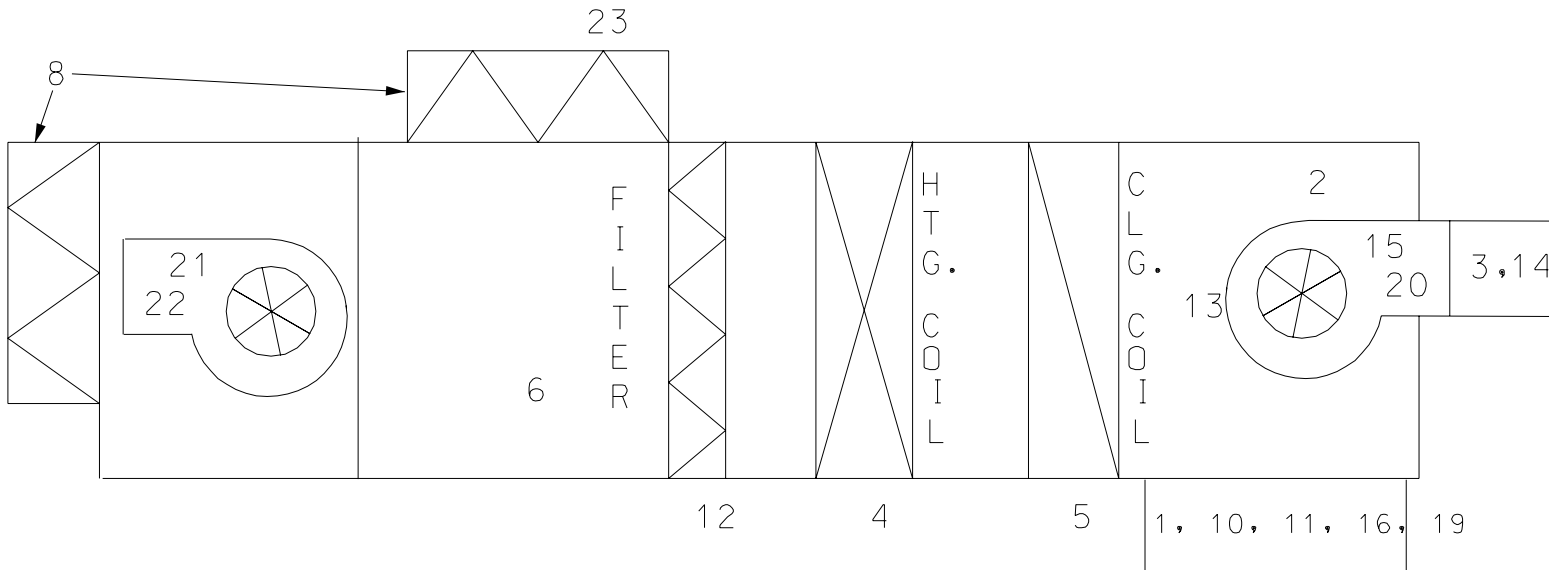
**GENERAL NOTES:**

1. CO2 SENSOR TO BE USED IN RETURN AIR STREAM FOR ACTIVE/DYNAMIC O.A. VENTILATION RESET.
2. BLDG PRESSURIZATION SHALL BE DYNAMIC/ACTIVE, DEGREE OF ADJUSTMENT SHALL BE OPERATOR ADJUSTABLE PER AHU.
3. EF-1 INTERLOCK WITH AHU-1 & AHU-4. UPON ENERGIZING EITHER ONE OR BOTH AHU-1 AND/OR AHU-4, EF-1 SHALL START.
4. EF-2 INTERLOCKED WITH AHU-2 & AHU-3. UPON ENERGIZING EITHER ONE OR BOTH AHU-2 AND/OR AHU-3, EF-2 SHALL START.

# Variable Air Volume Air Handler With Unit Controller

REMOTE

7, 9, 17, 18



## UNIT CONTROLLER

1. Control panel communications
2. Supply fan status indication
3. Supply temperature
4. Heating coil
5. Cooling coil
6. Mixed air temperature
7. Outside air temperature
8. Outside air/return air economizer actuator
9. Space temperature
10. Remote setpoint
11. Mixed air low limit status
12. Filter status
13. Average coil discharge temperature
14. Supply fan static pressure
15. Fan modulation control
16. Setpoint reset outside air/space temperature
17. Timed override
18. Critical zone damper position
19. VAV box heat lockout
20. Supply fan start/stop
21. Return Fan Start/Stop.
22. Return Fan modulation
23. Carbon Dioxide Sensor

AI	AO	BI	BO
		X	
		X	
X			
	X		
	X		
X			
X			
X	X		
	X		
		X	
		X	
X			
			X
			X
			X
	X		X
X			

PART 4 SEQUENCE OF OPERATIONS

4.01 VARIABLE AIR VOLUME TERMINAL UNITS

A. Direct Digital Controls

1. General: DDC Controls and factory work to mount, calibrate and test the system shall be per Section 15951 (Direct Digital Control for HVAC), and shall be paid by the Contractor, complete. This work shall be done at no additional cost to the Government. Damper actuator shall be the responsibility of the VAV box manufacturer and shall be a three wire, 24VAC motor.
2. Terminal unit manufacturer shall provide price for factory mounting, continuity check, calibrating, and testing of direct digital controls to the Contractor (ATC contractor). Field mounted DDC controls are not acceptable.
3. Multi-point, multi-axis flow ring or cross sensor to be furnished and mounted by terminal unit manufacturer. Single point or flow bar sensors are not acceptable. Shall be capable of maintaining airflow to within +/- 5 percent of rated unit airflow setpoint with 1.5 duct diameters straight duct upstream from the unit.

B. VARIABLE AIR VOLUME (VAV) TERMINAL UNIT CONTROL

1. The VAV terminal units shall be individually controlled by a DDC VAV controller per VAV terminal unit. The DDC VAV controller, damper motor, transducer and transformer shall be supplied and furnished by the terminal unit supplier. The cost and task to factory mount, calibrate and test the controller, transducer, transformer and actuator shall be included as part of the Contractor's required work. This shall be done at no additional cost to the Government.
  - a. To assure proper operation and control, the BAS contractor shall recalibrate the transducers six (6) months after acceptance of the BAS system to correct any deviations as a result of transducer drift. This shall be part of The Contract, and shall be done at no additional cost to the Government.
2. Submit a copy of the recalibration report to the Mechanical Contractor, Testing-Adjusting-and-Balancing Contractor. Additionally, a total of 7 copies are to be submitted to the Field Contracting Officer Representative (COR). Quantities may be less, subject to the discretion of the COR.

3. The BAS shall perform the following VAV Terminal unit control strategies and provide the points as listed on the DDC/VAV point list and the specified monitoring and diagnostics.
  - a. Grouping - The BAS shall be able to group VAV boxes via keyboard commands. These groups shall make it possible for the operator to send a common command to all boxes in a group to operate in the same mode. A sample of this group report must be provided in the design submittal package for approval by The Design Engineer (or, Contracting Officer Representative). BAS shall also compile on a group basis, the following:
    1. Minimum group temperature
    2. Maximum group temperature
    3. Average group temperature
    4. Current airflow through boxes in group (total)
  - b. Setpoint Control - The BAS shall edit the zone space temperature setpoint of each VAV box. The zone temperature setpoint shall be operator adjustable. Individual zone setpoint and control logic shall reside at the zone level, and not be dependent upon the BAS for control. This project shall utilize zone temperature sensors, not occupant adjustable thermostats. In the event of communication loss, the box will continue to control to current setpoints.
  - c. Cooling Air Valve Control - The BAS shall control the cooling air valve to a fully open, fully closed, maximum CFM, or minimum CFM position based on operator commands. The operator shall also have the capability to adjust the maximum & minimum airflow limits of the air valve through the BAS.
  - d. Operating Mode - The BAS shall place the box in either the occupied or unoccupied mode based on an operator adjustable time schedule. Separate heating & cooling setpoints shall be enterable for each mode through the BAS. Other modes available for special applications shall include full open, full closed, maximum flow, and minimum flow.
  - e. Control Offset - The BAS shall be capable of offsetting the cooling or heating setpoints of one or more groups of boxes by an operator adjustable amount. This capability will allow for automatic zone setpoint changes based on system requirements, such as demand limiting.

- f. Automatic Recalibration - The system shall automatically recalibrate its air flow sensing & air valve position measurement system at system startup and on a scheduled basis.
- g. Remote Setpoint Adjustment - Not applicable option on this project.
- h. Override Button - The VAV box shall be capable of being placed in the "occupied" mode by pressing an override button mounted on the zone temperature sensor.
- i. Terminal unit status reports - For each terminal unit, the BAS shall provide an operating status summary of all unit sensed values (zone temperature, CFM, etc.), setpoints, and modes.
- j. Terminal unit group report - For each group of VAV terminal units, the BAS shall report the group mode, heating and cooling airflow, average zone temperature, minimum zone temperature, and maximum zone temperature. The report shall also display for each terminal unit in the group the present temperature control setpoints and the current zone temperature.

4. Zone Sensors

- a. The zone sensor shall be accurate to within 0.5 F. The sensor shall be a product of the VAV box controls manufacturer and designed specifically for the installed controller.
- b. The zone sensor shall have the following features:
  - 1.) Zone setpoint adjustment
  - 2.) Night setback temperature override button to provide occupied conditions during unoccupied times.
  - 3.) Night setback override cancel button to end the override condition.

5. Terminal box diagnostics.

- a. If zone temperature sensor input fails above its high range, unit shall control at its maximum CFM setpoint. If sensor input fails below its low range, unit shall control to its minimum CFM setpoint.
- b. In both cases, all heat outputs shall be disabled. a diagnostic message shall be displayed upon operator inquiry.
- c. If flow measuring system fails, unit shall automatically convert to a pressure dependent, damper position based algorithm. Diagnostic message shall be displayed upon operator inquiry.
- d. If zone temperature setpoint potentiometer on zone sensor fails, unit shall automatically control to programmed occupied setpoints. Diagnostic message shall be displayed upon operator inquiry.
- e. If communications are lost, controller shall continue to operate in the current mode of operation. All setpoints shall be retained in nonvolatile memory. If communications are not restored within 15 minutes, unit shall automatically initiate a reset-recalibrate.

#### 4.02 SEQUENCE OF OPERATION, FAN POWERED UNITS

##### A. DDC Controls

##### 1. Intermittent Fan Control--Occupied Cycle

##### a. Occupied Cycle

As the space temperature rises above the cooling setpoint, the terminal unit shall modulate toward its maximum CFM. As the space temperature falls below cooling setpoint, the terminal unit shall modulate toward its minimum cooling CFM. Upon a continued drop in temperature and/or unit CFM, the parallel fan will be energized. Upon a further decrease in space temperature, the terminal unit will modulate to heating minimum CFM. The heating will then be staged on as follows:

Proportional Hot Water Control Valve - Below heating setpoint, modulate the hot water valve as required to maintain the active heating setpoint.

##### b. Unoccupied Cycle

During the unoccupied cycle, the air valve on the terminal unit shall drive closed. The fan and heat shall cycle to maintain a reduced (setback) space temperature.

2. Series Fan Powered Units

a. Occupied Cycle

The unit fan shall operate continuously. Upon a rise in space temperature above cooling setpoint, the terminal unit shall modulate to provide maximum cooling CFM. A drop in space temperature will result in the unit modulating to provide its minimum cooling CFM. As the space temperature continues to fall, the unit shall modulate its cooling flow to its minimum heating CFM and energize the heat as follows:

Proportional Hot Water Control Valve - Below heating setpoint modulate the hot water valve as required to maintain the active heating setpoint.

b. Unoccupied Cycle -During the unoccupied mode, the primary air valve shall modulate fully closed. The terminal fan and heat shall cycle as needed to maintain a reduced space (setback) temperature.

\*\* END OF SEQUENCE SECTION \*\*

## SYSTEM POINT LIST (FOR ALL VAV TERMINALS)

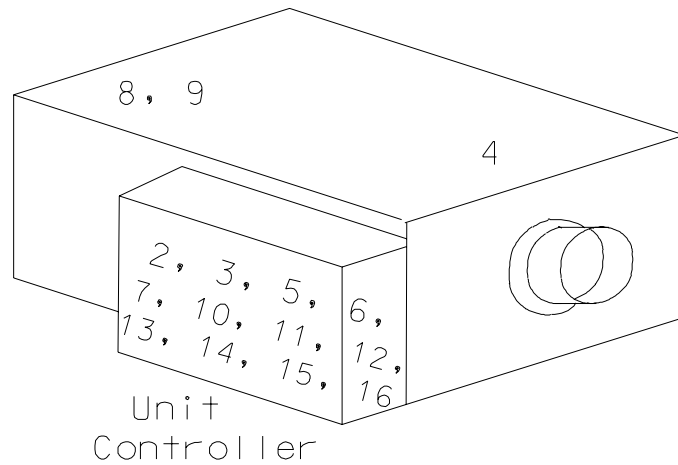
[illegible]

<b>GENERAL NOTES:</b>	GENERAL: VAV-4-8 & VAV-4-9 ARE SERIES FAN POWERED, ALL OTHERS ARE PARALLEL FAN POWERED. HOT WATER VALVES SHALL BE 2-WAY MODULATING TYPE.
	ALL VAV AIR TERMINALS SHALL BE USED IN CONJUNCTION WITH RESPECTIVE AHU FOR SUPPLY FAN PRESSURE OPTIMIZATION (THROUGH CRITICAL ZONE I
	NOTE 1. SEE CONTRACT DWG M-602, FAN POWERED VAV TERMINAL (WITH HEATING COIL) SCHEDULE.
	NOTE 2. "TIMED OVERRIDE", AND "TIMED CANCEL" FEATURE TO BE PROVIDED AT ALL VAV TERMINAL ZONES.

## SYSTEM POINT LIST (FOR ALL VAV TERMINALS)

[illegible]

# VAV Boxes with Unit Controller



Remote  
1, 17

VAV Groups
A
B
C
D
E

## Per Single Box

1. Zone temperature
2. Occupied heating setpoint
3. Occupied cooling setpoint
4. CFM
5. Maximum CFM setting
6. Minimum CFM setting
7. Heating minimum CFM
8. Heat status
9. Fan status
10. Unoccupied heating setpoint
11. Unoccupied cooling setpoint
12. Fan energization setpoint
13. Control offset
14. Override open
15. Lockout fan
16. Lockout heat
17. Timed override request from space

AI	A0	BI	B0
X			
	X		
	X		
X			
	X		
	X		
	X		
		X	
		X	
	X		
	X		
	X		
			X
			X
			X
			X
		X	

## Per Group of Boxes

- A. Maximum temperature
- B. Minimum temperature
- C. Average zone temperature
- D. Total flow
- E. Total heating flow

AI	A0	BI	B0
X			
X			
X			
X			
X			

## PART 4 SEQUENCE OF OPERATIONS

### 4.01 ANCILLIARY EQUIPMENT CONTROLS – CABINET UNIT HEATERS, EXHAUST FANS, BOILERS, PUMPS, GAS AND ELECTRIC METERS, ETC.

#### A. CABINET UNIT HEATER AND UNIT HEATERS

1. The Cabinet Unit Heater – Cabinet Unit Heater (CUH-1) is to be under DDC Control. The Cabinet Unit Heater maintains setpoint by way of a 2-way modulating hot water control valve. The Unit shall be energized by the building's DDC system, when the building is placed under the occupied mode the unit's fan shall energize. The control valve shall be a normally-open valve and shall cycle to maintain setpoint temperature. The unit shall be capable of having its setpoint remotely adjustable through the DDC system. When the unit is under the non-occupied mode the unit shall be de-energized.  
Setpoint shall be set at maintain 68°F.
- 2a. Unit Heaters – Unit Heaters, UH-1, UH-2, UH-3 maintain room setpoint temperature by means of fan cycling. The Units' setpoint shall be capable of being remotely adjustable by the DDC system. The Unit shall maintain setpoint temperature of 45°F during the heating season (when outdoor air temperature is below 60°F). When not in the heating season the unit shall be "OFF".
- 2b. For UH-1 (Fire Pump Rm #131), UH-2 (Elec. Rm #128) & UH-3 (Mech. Equip. Rm #132), each room which the units are to be located, there shall be a low limit and a high limit alarm connected to the DDC system. When the low limit temperature in the room is violated, an alarm shall be sent to the DDC Controls Operator. The alarm can only be reset manually when triggered. The high limit alarm shall function in the same manner, when the room's temperature exceeds the high level alarm setting, a signal (latching and adjustable) shall be sent to the DDC Controls Operator. The alarm can only be reset manually when triggered.
- 2c. For UH-4 thru UH-11, all located in the Mechanical Fan Rm #301, the units shall maintain setpoint temperature by means of 2-way hot water modulating valve. All the units are to be connected to the DDC system. The units shall be initiated (energized) through the DDC manually. The intent is to maintain a cold roof, therefore, the units are to be energized only manually (set to maintain space temperature for a predetermined time span interval as a default) through the DDC system. Otherwise, the units are to be "OFF" at all time. The controls for all the Unit Heaters in Mechanical Fan Rm #301 may be grouped together, however, their individual room thermostats shall remain individually dedicated to each respective Unit Heater.

Setpoint shall be adjustable, and set to maintain 55°F. Mechanical Fan Rm #301 shall have a room temperature sensor, and a high level temperature alarm connected to the DDC system. The high level temperature alarm (latching and adjustable) in the room shall only be reset manually once triggered.

## B. EXHAUST FANS

1a. Exhaust Fan EF-1 (North-end Toilet Exhaust Fan) shall be interlocked with AHU-1 and AHU-4. When either AHU-1 or AHU-4, or both AHU-1 and AHU-4 is energized, EF-1 shall be "ON". When both AHU-1 and AHU-4 are "OFF", EF-1 shall be "OFF". EF-1 shall be connected to the DDC system and capable of being manually energized, or de-energized; and it shall have an alarm to indicate fan failure to operate and alert (latching signal alert, and adjustable) the Controls Operator.

1b. Exhaust Fan EF-2 (South-end Toilet Exhaust Fan) shall be interlocked with AHU-2 and AHU-3. When either AHU-2 or AHU-3, or both AHU-2 and AHU-3 is energized, EF-2 shall be "ON". When both AHU-2 and AHU-3 are "OFF", EF-2 shall be "OFF". EF-2 shall be connected to the DDC system and capable of being manually energized, or de-energized; and it shall have an alarm to indicate fan failure to operate and alert (latching signal alert, and adjustable) the Controls Operator.

1c. Exhaust Fans EF-3 (Rm#114) , EF-4 (Rm#116) & EF-5 (Rm#246) shall be inversely interlocked with EF-1 (North-end Toilet Exhaust Fan) in such fashion that when EF-1 is "OFF", EF-3, EF-4 & EF-5 are "ON".

Similarly, when EF-3, EF-4 & EF-5 are "ON", EF-1 is "OFF".

The intent is to ventilate rooms #114, #116 & #246 when EF-1 is "OFF".

Rooms #114, #116 & #246 shall each be DDC connected with a Temperature Sensor, and a High Level Temperature Alarm. The Temperature Sensor will provide the room's real-time temperature reading, and the High Level Alarm will provide an alert signal (latching and adjustable) to the DDC operator when the high level temperature setpoint has been violated.

1d. Exhaust Fan EF-6 (Rm#237) shall be inversely interlocked with EF-2 (South-end Toilet Exhaust Fan) in such fashion that when EF-2 is "OFF", EF-6 shall be "ON".

Similarly, when EF-6 is "ON", EF-2 is "OFF".

The intent is to ventilate room #237 when EF-2 is "OFF".

Rooms #237 shall be DDC connected with a Temperature Sensor, and a High Level Temperature Alarm. The Temperature Sensor will provide the room's real-time

temperature reading, and the High Level Alarm will provide an alert signal (latching and adjustable) to the DDC operator when the high level temperature setpoint has been violated.

- 2a Exhaust Fans EF-7 (Rm#131), EF-8 (Rm#132), EF-9 (Rm#128) & EF-10 (Rm#301) shall operate to maintain room setpoint temperature. Set point for each fan shall be set at 85°F. Since EF-7, EF-8, & EF-9 are 2-speed fans, they shall have their 2<sup>nd</sup> setpoint set at 95°F.

In each room (#131, #132, #128 & #301), there shall be a room temperature sensor, and a High Level Temperature Alert (latching and adjustable) in each room. The temperature sensor will provide real-time temperature reading of their respective room; and the High Level Temperature Alert shall provide an alert signal to the Controls Operator when a room's temperature has been exceeded.

In addition to a High Level Temperature Alert in each room, each room (#131, #132, #128), with the exception of Rm#301 shall also have a Low Level Temperature Alert (latching and adjustable). Once triggered a signal will be provided to the DDC Controls Operator. No Low Level Temperature Alert for Rm#301 need be provided since it is the intention to keep Rm#301 unheated. EF-10 shall be provide with a fan failure notification capability via the DDC system.

#### C. BOILERS SYSTEMS CONTROL AND HOT WATER PUMPING CONTROL

- 1a. The heating system generates hot water by the use of four (4) boilers (B-1 thru B-4). The boilers are arranged for multiple firing arrangement – each boiler shall only energize on demand sequentially, and when temperature can be maintain with less/fewer boiler, then one or more boiler will cycle “OFF”. The control of the boiler sequential firing and cycling “OFF” , shall be controlled by the Boiler Control Panel (see section 15569). The Hot Water Supply temperature shall be set based on a Outdoor Temperature versus Supply Water Reset Schedule. The setting shall be (adjustable):

<u>Outdoor Temp.</u>	<u>Vs.</u>	<u>Supply Hot Water</u>
-21.7°C (-7°F)		93.3°C (200°F)
15.6°C (60°F)	60.0°C (140°F)	

- 1b. The boiler control capability shall be as specified in section 15569. The DDC System shall initiate operation of the heating system, subsequently, the boiler control will then control operation of the heating system. Primary Hot Water

Pumps (PHWP-1 thru PHWP- 4) will either be energize by the Boiler Control Panel or the DDC system. Secondary Hot Water Pumps (SHWP-1 thru SHWP-2) will be initiated through a flow switch (located in Primary Loop) or through the Boiler Control Panel. The Secondary Hot Water Pump will be controlled by its VFD Control Panel (see Section 15541, Variable Speed Pumping). Direct communication shall be established between Variable Speed Pump Control Panel and the DDC System, since the Variable Speed Pumping Panel shall feature BACnet protocol.

- 1c. Variable Speed Pumping shall be controlled through the use of differential pressure sensors (total of 4 sensors) located at various locations in the Secondary Piping Loop (see Contract Drawings for locations).

#### D. CHILLERS CONTROL, AND CHILLED WATER CONTROL SYSTEM

- 1a. The Chillers shall be energized through the DDC System. The chillers shall operate as described under Section 15951A, Sequence of Operations for Air Cooled Helical Rotary Chillers System Control. Primary Chilled Water Pump (PHWP-1 thru PHWP-4) shall also operate as described under the same Section.
- 1b. Variable Speed Secondary Chilled Water Pumps (SCHWP-1 & SCHWP-2) shall operate by means of a system flow switch. Control of the Secondary Chilled Water Pumps shall be as described under Section 15541, Variable Speed Pumping.
- 1c. Variable Speed Pumping shall be controlled through the use of differential pressure sensors (total of 4 sensors) located at various locations in the Secondary Piping Loop (see Contract Drawings for locations). Direct communication shall be established between Variable Speed Pump Control Panel and the DDC System, since the Variable Speed Pumping Panel shall feature BACnet protocol.

#### E. GAS METER CONNECTION AND ELECTRIC METER

- 1a. The DDC System shall be connected to receive pulse signal so that Gas Meter and Electric Meter readings can be taken remotely by the Controls Operator.

F. COMPUTER ROOM UNITS

- 1a. Computer Room Units shall be under local control.
- 1b. Rooms installed with Computer Room Units shall be provide with sensor to monitor the room's temperature. Each room shall be provided with a High Limit Temperature Alert. The High Temperature Limit Alert shall provide a latching signal (adjustable) to the Controls Operator when the room's temperature limit has been exceeded. The Alert shall only be reset manually once activated.

\*\* END OF SEQUENCE SECTION \*\*

SYSTEM POINT LIST (FOR CONTROL PANEL, CUH & UH's)

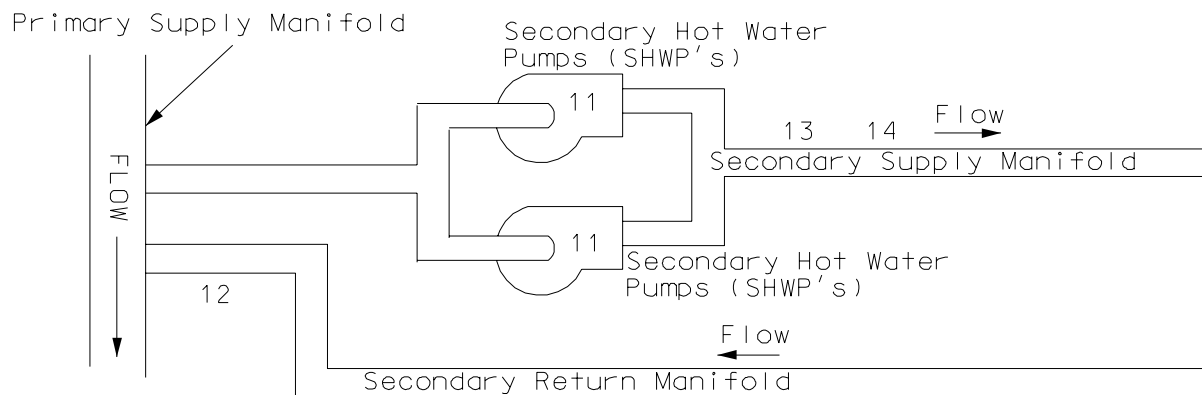
SYSTEM POINT DESCRIPTION		ANALOG											BINARY				SYSTEM FEATURES															NOTES:																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																															
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CONTROL PANEL & UNIT HEATERS	GRAPHIC	TEMPERATURE	PRESSURE	RH	KW	BTU HR	GPM	PERCENT	CFM	SETPOINT	DDC (4-20 ma, 0-10 vdc)	SETPOINT ADJ.			STATUS ON/OFF	FILTER STATUS	STATUS OPEN/CLSD.	STATUS	NO. OF STARTS	TIMED OVERRIDE	OFF/ON	OPEN/CLOSED	LOCKOUT	ENABLE /DISABLE	HIGH/LOW			HIGH ANALOG	LOW ANALOG	HIGH BINARY	LOW BINARY		PROOF	SENSOR FAIL	FLOW FAIL	COMM. FAIL	LATCHING	DIAGNOSTICS	TIME SCHEDULING	DEMAND LIMITING	OP. START/STOP	RESET	EVENT PROGRAM	DDC	ALARM INSTRUCT	MAINT. WK. ORDER	RUN TIME	EXP. MESSAGE	SET BACK /SET UP	NIGHT PURGE	TENANT BILLING	CHILLER SEQUENCING	TOTALIZING	TIMED OVERRIDE																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																									

## SYSTEM POINT LIST (FOR EFs & CRUs)

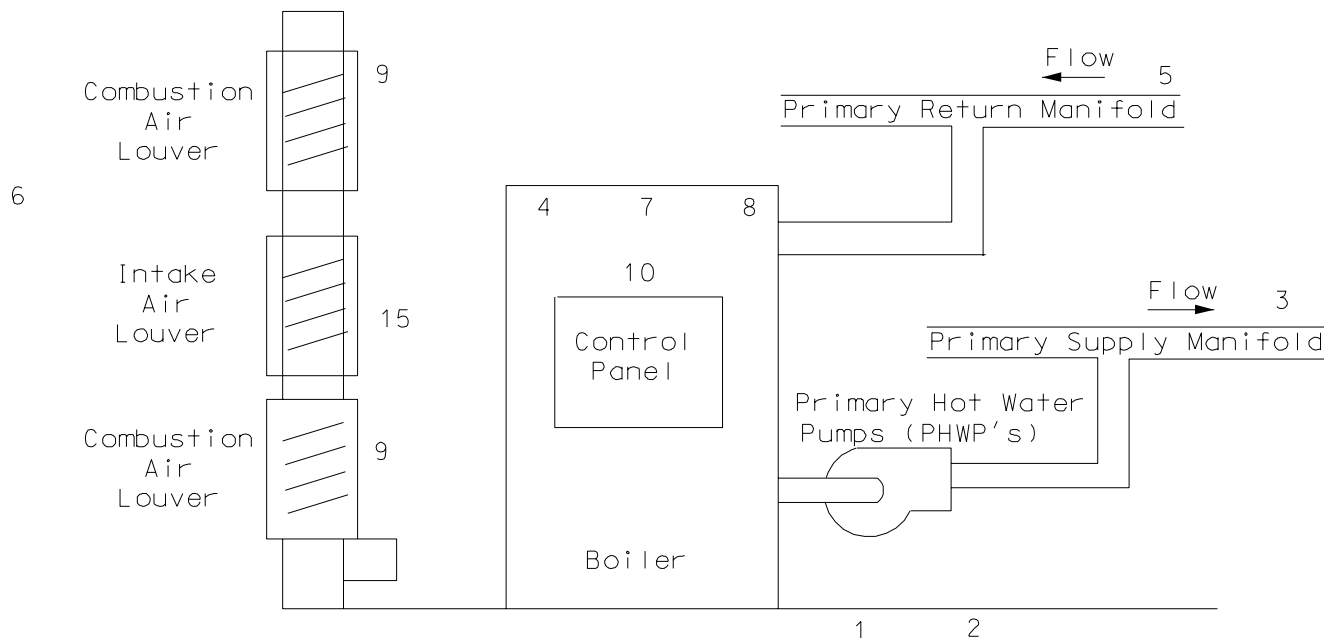
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## SYSTEM POINT LIST (B-1, B-2 B-3 & B-4)

[illegible]



SECONDARY PUMPS AND SECONDARY PUMPING LOOP



BOILERS AND PRIMARY PUMPING LOOP

1. Hot water pump control
2. Hot water pump status
3. Hot water supply temperature (at manifold)
4. Hot water supply setpoint
5. Hot water return temperature (at manifold)
6. Outdoor air temperature
7. Boiler alarm (general)
8. Boiler start/stop control (enable/disable)
9. Combustion air open/close control
10. Boiler Flow
11. VFD hot water pump signal
12. Secondary HW Return Temp. (at manifold)
13. Secondary HW Supply Temp. (at Manifold)
14. Secondary HW Flow (GPM at Manifold)
15. Intake air open/close (interlock w/EF-8)

AI	AO	BI	BO
			X
		X	
X			
	X		
X			
X			
		X	
			X
			X
		X	
	X		
X			
X			
	X		
			X